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NOTES AND COMMENTS

Latin America and the Common Market[1].

Since the Second World War, from 60 to 65% of the world's sugar supply has consisted of cane sugar produced in tropical and sub-tropical regions. The remainder has been produced from beet in the temperate zones, chiefly in Europe and the United States. Some Latin American sugar producers have feared that the formation of the European Common Market may stimulate production of cane sugar in the African dependencies. But consideration should also be given to the possibility of increased production of beet sugar in the ECM countries themselves, if their agricultural development plan, yet to be developed, should raise the efficiency of European agricultural production.

Sugar cane requires a warm growing season and a relatively rich soil. For highest sugar yield, however, it is desirable that the weather be relatively dry and slightly cooler, but without frost, for a period shortly before the harvest than during the main growing season. These conditions are approximated in some parts of the African dependencies. But in most of the lowlands of this region temperatures tend to remain uniformly warm. Furthermore, there is a tendency in most African regions for rain to fall rather erratically. Consequently, most of the French and Belgian dependencies are not particularly suitable for sugar cane, except for some territory in the Belgian Congo. There is, however, heavy sugar production on Réunion, and conditions for sugar cane are believed to be favourable on the east coast of Madagascar. Sugar cane production might be increased here and in some other limited areas for the benefit of the ECM countries.

It is evident that the post-war growth in sugar production will continue. A survey of expansion plans in various countries early in 1957 showed that over 100 factories were to be built, of which 9 are in Africa. Only two of these, however, are to be in dependencies of France and Belgium. It is possible that the large prospective increases in production elsewhere will discourage further expansion in Africa, thus averting one possible source of competition for Latin America.

In a long-term projection of international primary commodity trade made by GATT, it was estimated that the population would increase 12·5% in Western Europe and 26% in North America between 1953–55 and 1973–75[2]. It is assumed that there will be an appreciable increase in *per capita* income in Western Europe as well as in North America. This may be expected to lead to greater consumption of the more palatable and refined foods, including sugar. Each 10% increase in *per capita* income is assumed to lead to a 5% expansion in food consumption and to a consumption of sugar greater by 2% in Europe and by over 3% in North America. This would seem to provide an outlet for such expansion in sugar production as is foreseeable in the near future.

An influence in the contrary direction is the continued support which the European countries give to their beet sugar industry by means of tariff protection and quotas and other import restrictions. When those indirect subsidies are counted, beet sugar production appears to be much more expensive than would the purchase of cane sugar. It is possible that the European Governments may not be willing to continue this production indefinitely at its present level. On the other hand, the ECM organization is committed to the development of a programme for encouraging and stimulating agriculture in its member countries. There are appreciable opportunities for increasing agricultural productivity in Europe, and sugar beet output may well be affected.

Briefly, there is in prospect a continued growth of demand for sugar, and this seems likely to be greater in North America than in Europe. At the same time, the increased numbers and capacity of sugar factories already planned can fulfil consumption requirements for several years in the future. There is not at present any serious reason to expect that Latin American sugar exports will be threatened by competition from Africa in the near future. There is more reason to be concerned about EEC plans and policies in Europe itself, and about the growing volume of production in other parts of the world.

[1] *U.N. Econ. Bull. for Latin America*, 1958, **3**, (1), 38–39.
[2] GATT, *International Trade, 1956*, pp. 16–35. (Geneva, 1957).

Sugar in Rhodesia.[1]

Within a few years developments which are in progress in Southern Rhodesia are expected to make the Federation self-sufficient in sugar; at present 90% of the annual requirements of 55,000 tons are imported from South Africa and Mozambique.

Work has begun on the spray irrigation scheme, to cost £325,000, at the Triangle Estate near Fort Victoria. This will use more than 27 miles of pipeline and is believed to be the largest single block of overhead spray irrigation in the world. It will water 3,600 acres of cane and bring the total acreage under cultivation at Triangle to 5,000. Last year sugar production by the small mill, with a capacity of only two tons of sugar an hour, amounted to 4,671 tons but the 1958 output will be much less as a large proportion of the cane crop has been used to plant new areas and replant canelands already established. The 1959 crop is expected to be not less than 15,000 tons and it will be crushed at a new factory eight miles from the present mill in the centre of the plantations. The new factory will be in operation in August and will have a capacity of 10 tons of sugar an hour. The crushing season lasts nine months.

At present only 60 cusecs of water are available at Triangle but when the £3m. Kyle dam, on which work is to be begun in about two years' time, has been completed an additional 100 cusecs will be on tap and it is planned to irrigate 16,000 acres all the year round. Besides closing the gap between domestic production of sugar and the Federation's requirements the Kyle dam projects will assist the rapid development of the fertile area surrounding the Triangle Estate. A new direct road to the Bulawayo-Lourenco Marques railway is being constructed through 40 miles of bush and and this will save 80 miles as compared with the present route through Fort Victoria. The Government and the sugar company are sharing the cost of this road.

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U.S. 1957 Sugar Crops.

The Crop Reporting Board of the U.S. Dept. of Agriculture have released their latest revised data in connexion with the 1957 crops of mainland sugar beets and sugar cane.

Production of sugar beets in 1957 set a record at 15,497,000 tons. This was 19% above 1956 and 10% above the previous record production of 14,082,000 tons in 1954. The 1957 average yield per acre of 17·7 tons also set a record, exceeding the 1956 record by over a ton. Production of beet sugar from the 1957 crop, at 2,047,000 tons of refined sugar, exceeded the 2 million ton mark for the first time. The first season in which beet sugar production exceeded the one million ton mark was in 1920.

Sugarcane harvested for sugar in 1957 amounted to 6,334,000 tons compared with 6,014,000 tons in 1956. The final production in 1957 was down about 12% from December 1957 estimate as a result of late freezes in Louisiana and Florida. Losses were heaviest in Louisiana where an estimated 600,000 tons were lost mainly as a result of topping back, but some cane was also abandoned in the field. The decreased production in Florida from the December estimate was due largely to a reduction in the amount of acreage harvested as the average yield of 41·7 tons per acre harvested is a new record for the State.

Production of sugar from the combined 1957 crops of sugar beets and sugar cane amounted to 2,724,000 tons, raw value, compared with 2,527,000 tons in 1956. The 1957 production was composed of 2,190,000 tons from beets and 534,000 tons from cane.

The value of the 1957 crops of sugar beets and sugar cane to grower amounted to $220 million, excluding payments under the Sugar Act. Sugar beet production was valued at $173·6 million and sugarcane including seed at $46·4 million.

* * *

United States Supply Quotas, 1958.[2]

An increase in the overall U.S. Supply Quota of 100,000 short tons was declared by the Dept. of Agriculture on 18th June. The quota stands now at 9,000,000 short tons. It was announced that the increase was necessitated by the fact that trade inventories for 1st June were below the corresponding ones for June 1957, whilst consumers' holdings were only moderate. Additionally, pressure to sell had eased due to the crops from the Caribbean area now being near completion and, reflecting this fact, the New York price was strong.

At the same time reallocations were made in respect of part of the quotas of Peru and Costa Rica. These two countries are not signatories to the International Sugar Agreement and the amount the United States is permitted to import from them is limited under Article 7(1)(i) of the Agreement. The tonnage lost by these territories has been reallocated amongst other full-duty countries.

Details of individual quotas as adjusted are as under:—

Raw sugar value	*Short tons*	*Long tons*
Domestic Beet	2,227,558	1,988,891
Mainland Cane	685,441	612,001
Hawaii	765,000	683,036
Puerto Rico	815,000	727,678
Virgin Islands	15,549	13,883
Philippines	980,000	875,600
Cuba	3,294,247	2,941,292
*Other Foreign Countries	217,205	193,933
	9,000,000	8,035,714
*Of which :—		
Peru	55,588	49,632
Dominican Republic	72,967	65,149
Mexico	52,555	46,924

[1] *Commonwealth Producer*, 1958, (365), 86.
[2] C. Czarnikow Ltd., *Sugar Review*, 1958, (36), 112.

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THE CONTROL OF ARROWING AND FUZZ PRODUCTION IN SUGAR CANE

Under Sub-Tropical Conditions

By N. D. YUSUF (Department of Agriculture, Lyallpur, West Pakistan.)

Introduction.

ALL over the world flowering in sugar cane presents a series of problems to cane breeders. Even under tropical conditions, where cane flowers freely, certain varieties do not flower at all, others flower sporadically and, in many cases, there is lack of synchronization in the varietal flowering seasons.

Fig. 1. Seedlings grown from seed produced at Lyallpur.

Outside the tropics, and particularly where climatic conditions are extreme, there are added difficulties. For instance, in Northern India and the whole of West Pakistan sugar cane either does not flower or, if some varieties flower in certain years, the flowers are sterile, hybridization is impossible and fuzz for raising new varieties has to be imported.

These facts raise problems of considerable practical importance and, over a long period, much study has been devoted to finding ways and means to induce and control flowering. These efforts followed two lines; either the application of chemicals of a hormonic nature or the adjustment of various ecological factors such as photo-period, temperature, irrigation and nutrient supply. Of these, the first has proved the more effective and different aspects have been described.[1–6] CHILTERN and PALIATSEAS reduced the day lengths over a period of 80–85 days by one minute a day, thereby inducing flower primordia in 34 out of 81 varieties tested, but made no mention of the subsequent development of these flowers, their fertility or seed formation.

From previous work conducted by the author at Coimbatore between 1942 and 1947, the following conclusions were drawn: (1) sugar cane is definitely sensitive to the " day - length " factor. Certain persistently non-flowering forms of *S. spontaneum* flowered freely when subjected to short-day conditions during the growth season while, in some others, flowering was delayed or hastened by two to three months by suitably adjusting the day-length. These responses were consistent and observed over several years. (2) In certain thick cane varieties flowering is invariably delayed, in some cases as much as two to three months, by slight alterations in day-length in either direction, a possible indication that the local day-length is the

[1] E. W. BRANDES and I. MATZ. *Sugar J.* (La.), 1939, **2**, (6), 3–6.
[2] N. D. YUSUF and N. L. DUTT: *Curr. Sci.*, 1945, **14**, (11), 304.
[3] N. D. YUSUF: *Pak. J. Sci.*, 1950, **2**, 36–49 and 71–86.
[4] S. LEE and K. S. LIN: *Proc. 7th Congr. I.S.S.C.T.*, 1951, 33–43.
[5] S. J. P. CHILTON and C. F. MORELAND: *Sugar Bull.*, 1954, **32**, (11) 165–169.
[6] S. J. P. CHILTON and E. D. PALIATSEAS: *Proc. 9th Congr. I.S.S.C.T.*, 1956, 1–5.

Fig. 2. Application of light treatment under field conditions.

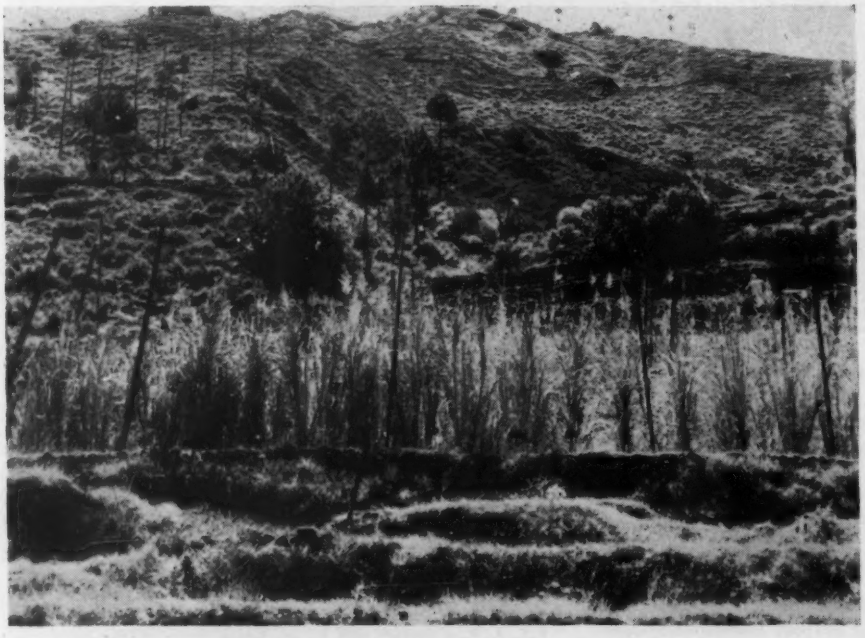

Fig. 3. Arrowing in different cane varieties under field conditions at higher altitudes.

"optimum" for these varieties. (3) A number of thick varieties produce normal and healthy flowers under conditions of profuse watering, particularly when nitrogenous manuring is completely eliminated.

The present investigation is based on the above work and was commenced at Lyallpur in 1950. Its primary object was to find some method or treatment to induce normal and healthy arrowing applicable to the extreme conditions prevailing in the Punjab and the neighbouring areas of West Pakistan where some 800,000 acres are under sugar cane annually, and thereby permit hybridization work to be undertaken locally, if only on a small scale.

Irrigation-cum-Light Treatment.

In the initial stage, some 60% of all varieties tested flowered freely in the field when watered profusely (daily or on alternate days) during the growth period. The flowers were, however, almost completely pollen-sterile and no viable seed was obtained even when irrigation was combined with changes in day-length; in fact, the latter often delayed arrowing and sometimes led to mal-formations.

In March 1953, potted plants of S 2302, a thin cane which flowers profusely under excessive irrigation, was watered twice daily in troughs. By the first week in November, the formation of floral primordia began, when the plants were divided into three series all of which were subjected to the light of 2000 watt "Mazda" lamps throughout the night, treatment commencing in the three series respectively at (*a*) approximately just after the formation of the primordia, (*b*) when the stalks had nearly reached the short blade stage and (*c*) when the arrows had emerged. Treatment continued till the arrows had ripened. The first series produced the largest quantity of viable seed, yielding some 1500 seedlings; the second yielded only some 50 seedlings and the third no viable seed.

In a repetition of the experiment in 1954/55, 10 varieties were planted. Of these six flowered in mid-December and all produced viable seed when subjected to the same light treatment. Seedlings raised from two arrows of each variety ranged from 50 to 500 (Fig. 1). In the next two seasons, the experiment was repeated with 21 varieties now grown not only in pots but in the field (Fig. 2). Under the

same condition of heavy watering and light treatment, 15 varieties flowered and of these 11 produced viable seed. A few only gave some 20–25 seedlings from two arrows, the majority gave between 500 and 600 and, in two varieties, over 1000. The evidence justifies the belief that, given more adequate equipment for controlling the light treatment, the yield of viable seed could be considerably increased.

A Study of the Altitude Factor

In 1950, contemporaneously with the above investigations, trials were begun in the hills near Murree to study the effect of altitude on the flowering of sugar cane (Fig. 3). Five varieties were grown at the five altitudes, 2000 ft (Chhattar), 2700 ft (Saligran), 3800 ft (Nandkot), 5000 ft (Bansragali) and 6500 ft (Sunny Bank). General lack of facilities, particularly of irrigation, led to failure in germination on planting in early May. In 1951, better facilities led to generally good germination at all altitudes, but in no case did the canes flower. At 2000 ft growth was practically normal, at 2700 ft and 3800 ft it was limited to 4–5 ft and, at above 4000 ft, it was extremely poor.

All the above plots were ratooned and, during the season 1952/53, were watered profusely throughout the growth period. The cold in December/January was exceptionally severe with heavy snow from which Nandkot (3800 ft) barely escaped. Here all five varieties arrowed profusely, every tiller bearing an arrow; some pollen fertility was observed in all five varieties, but viable seed, from which a few seedlings were raised, was obtained from one variety only in which flowering had been delayed.

The five varieties were again ratooned at Nandkot for the 1953/54 season and they, and an additional five varieties, planted. Good growth was obtained in all cases, both plant and ratoons; and flowering, commenced in mid-February, continued to the end of June. Of each of the six varieties flowering profusely five arrows were bagged and all yielded viable seed with seedlings ranging from 50 to 500 per arrow.

The plots containing the 10 varieties were ratooned for the 1953/55 season both at 3800 ft and 2700 ft, and the number of varieties was increased to 15 by fresh plantings. Excellent growth was obtained at Nandkot, all but two of the varieties flowered and flowering extended from mid-February to the end of May. Viable seed was obtained from 11 of the 15 varieties, some yielding up to several thousand seedlings. Germination was best during June and superior in the case of seed derived from the ratoon crop. At Saligran, only four of the 10 varieties to flower set viable seed.

A further 10 varieties were added at each station for the 1955/56 season, and the old plots were ratooned. Some of these were seedlings raised from fuzz imported from Barbados in 1949/50. With one exception, growth was excellent and, at Nandkot, 19 of the 25 varieties arrowed, commencing mid-March. But severe storms at the end of that month did considerable damage and fuzz was collected from only 15 varieties, of which 13 only yielded viable seed. Viability differed widely with the variety and, again, germination was optimum in June.

It is a distinctive character of the sugar cane when grown at these altitudes that the flowering season is long, lasting from January/February to the end of July. This applies not only to the sugar cane in general but to the individual varieties; under more normal conditions, as at Coimbatore, the arrowing period of any particular variety covers a period of two to three weeks only.

As a result of these investigations, a dual means has been found for obtaining viable seed of the sugar cane under environmental conditions in which such seed has not normally been collected. The first method involves a modification of the environment by the artificial application of abundant irrigation with control of the day-length; the second is an exposure to the presumably adverse conditions prevailing at altitudes between 2500 ft and 4000 ft.

AGRICULTURAL ABSTRACTS

Ratoon Stunting Disease in Louisiana. *Phytopathology* 1957, **47,** 535 ; through *Hort. Abstr.* 1958, **28,** 145.—Control of the disease with hot air is now being used on a commercial scale in Louisiana. After treatment according to the recommended procedure infected setts produced shoots free of the disease. In other cases, where the disease was present in treated material, the incidence of infection was higher in the progeny setts than in the crop grown from the treated setts. Therefore, treated setts are being treated again in an effort to eliminate the disease. Results have shown that after the disease is eliminated from a variety it regains some if not all of its former yielding capacity.

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Sugar Beet Pulp for Feeding. Anon. *Ministry of Agriculture, Fisheries and Food Advisory Leaflet* 363 (1958).—The feeding value of sugar beet pulp, *wet, pressed* or *dried,* for all classes of livestock is outlined. Annual production of pulp throughout the British Isles amounts to some 350–375 thousand tons—no mean contribution to the feeding resources of the countries' livestock. Attention is drawn to the care necessary in feeding pulp to pigs owing to its high fibre content. The best methods of employing pulp in meeting the nutritional requirements of different classes of livestock are indicated.

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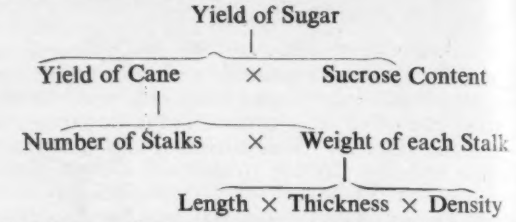
Sugar Beet Pests. F. G. W. Jones. *Ministry of Agriculture, Fisheries and Food Bull.,* 1958, (162), 63 pp.—Together with Bull. No. 142 *Sugar Beet Diseases* this replaces the earlier bulletin No. 93 *Pests and Diseases of Sugar Beet.* A companion bulletin No. 153 *Sugar Beet Cultivation* is also available. In this new bulletin there are two main sections—"Seedling Pests" and "Pests of the Established Crop". Each pest is fully described as are the recommended remedial measures. The excellent coloured plates should render recognition of any sugar beet pest in the British Isles easy.

BUNCH PLANTING

BUNCH planting of seedlings was introduced in Hawaii as a response to labour shortage and the system has been described in considerable detail by A. J. MANGELSDORF.[1] As practiced, two stages are involved : a polycross provides the fuzz, so that only the ♀ parent is known, and seedlings are planted out in groups ranging from a minimum of 5 to a maximum of 15 making vegetative vigour a primary agent for selection. It has been criticized[2] on both grounds but mainly on the former. Nowhere outside Hawaii has the system been adopted as the standard method for commercial selection.

The second stage has now been submitted to a critical examination by J. C. SKINNER in Queensland[3] using fuzz from the polycross Trojan (♀) and Co 281, POJ 2878, Eros, Q 36, Pompey, POJ 2940, Comus and G 270 (♂), all of which had given a high proportion of selected seedlings. In all, 284 bunches and 203 individual seedlings selected at random were planted, the latter giving a high selection rate of 7·4%. From the bunch plantings 1522 stalks were obtained, almost all from different seedlings. Selection among these was made on external characters only to form 3 grades, (a) 100 best, subdivided as 4 exceptional, 56 very good and 40 good, (b) 100 selected after 50% of the best stalks had been discarded and (c) 50 of the worst. The 3 grades, with 15 of the 203 individual seedlings, selected in the standard manner were planted in 2 sett, "5 × 3" plots, with Pindar as standard after recording a number of morphological characters plus Brix, and the 165 seedlings graded at 9 and 12 months on those component characters which go to make up a high yield of sugar per acre and are indicated in :—



The data so obtained are submitted to critical statistical analysis by which the relative influence of heredity and environment is determined.

A summation of the results shows a superiority of high significance of the best bunch selections over the random, single planted seedlings. A leading character in selection from bunches is what is termed "condition of the top"—a rather nebulous term in that it is incapable of mathematical measurement but sufficiently accurately graded on a 1-7 scale (very poor to excellent). Its importance lies in the fact that it is indicative of a capacity to synthesize sugar, to shade the ground and to maintain late growth ; it has a high negative correlation with arrowing and is fairly closely correlated with both Brix and stalk length.

H.M.-L.

AGRICULTURAL ABSTRACTS

Preliminary Notes on Overhead Irrigation of Sugar Cane in Mauritius. G. MAZERY. *Rev. Agric. Sucr.* (Mauritius), 1957, **36**, 231–240.—Small-scale experiments in overhead irrigation have been conducted since 1953 but have proved inconclusive. With funds provided by Government and the Sugar Industry Reserve Fund, a large scale experiment is being undertaken. The article discusses such irrigation in its various aspects particularly as applied to the gravelly soils of the sub-humid zone in which irrigation is necessary for economic cultivation and where a saving of water would allow a large increase in acreage. Economic and agronomic factors are considered, among the latter, the several methods of determining the water content of the soil and a modification of the Bouyoucos plaster block is described. The relative advantages of 100% portable and semi-portable systems are also discussed. Overhead irrigation is likely to be the most profitable in the Rivière Noire and the North-West but, both on the gravels of the North-East and along the South Coast,, a varying rainfall leads to large differences in yield and a more efficient use of available water would be profitable.

The Effect of Tropical Cyclones on the Sugar Crop of Mauritius. A. D. SWAN. *Rev. Agric. Sucr.* (Mauritius), 1957, **36**, 241–246.—Nearly 50 years ago (1910) A. WALTER undertook a study of the rainfall in Mauritius in an attempt to discover a basis for insurance against cyclones.[4] Here a review is given of the 74 cyclones occuring during the last 100 years and the measure of intensity adopted is the maximum mean velocity (m.p.h.) maintained over a whole hour. As pointed out, one major difficulty is to secure an objective and reliable estimate of what the crop would have been had there been no cyclone. The conclusions arrived at are summarized in a diagram with the "x" axis, dates from 1 November to 1 June, and the "y" axis cyclone intensity from 20 m.p.h. to 60 m.p.h. Curves are drawn indicating equal intensities of damage ranging from 3% for cyclones of low intensity early in the season to 50% for cyclones of maximum intensity late in the season.

[1] *Hawaiian Planters' Record*, 1953, **54**, 101 (vide *I.S.J.*, 1953, **55**, 329).
[2] *I.S.J.*, 1957, **59**, 299.
[3] *Tech. Comm., Bureau Sugar Expt. Sta.*, 1957, (1).
[4] *I.S.J.*, 1934, **36**, 150.

Recent Developments on Soil and Water Conservation in Taiwan. TIEN-TSO CHANG. *Taiwan Sugar*, 1957, **4**, (7), 22–25.—The methods adopted for terracing and contour planting on the hilly lands are both described and illustrated.

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Abstracts in Taiwan Sugar Cane Agriculture. C. F. CHENG. *Taiwan Sugar*, 1957, **4**, (7), 27–30. Statistical data are given for the post-war years. These show : that area (ha) and yield (1000 metric tons sugar) have risen from 78·5 and 86 respectively in 1945–46 to 92·4 and 820 (estimated) in 1956–57; that some 150,000 peasants raise cane on fields averaging between 0·40 and 0·45 ha ; that N:Co 310 now occupies over 91% of the area ; that the area under ratoons has increased to the extent that 5,273 ha only is set aside for seed cane against 18,545 ha in 1949–50 ; and that sugar yield per ha per month has risen from 261 kg in 1947–48 to 661·5 kg in 1954–55.

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Summary of Experimental Work on Sugar Cane, 1955–56. F. T. TABAYOYONG. *Sugar News*, (Philippines), **33**, 635–643.—The summary forms Release No. 13 of the Victorias Milling Co's Experiment Station. A wide range of experiments is covered and discloses interesting facts. Thus there is an increasing incidence of growth failure in the uplands which constitutes some 90% of the district's area. It is due to high acidity with pH $< 4{\cdot}5$ which appears to be the critical level. In these cases, liming is essential. Varietal and manurial experiments are reviewed together with control measures for weeds, diseases and pests. For the control of the major disease, leaf scorch, reliance is chiefly placed on varietal resistance, while for woolly aphis the systemic insecticide "Pestox" has proved itself; of the four species of *Trichogramma* tried, *T. japonicum*, *T. australicum*, *T. nanum* and *T. minutum*, the first two are the more active and breed faster.

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Variety x Fertilizer Test (6×6 Factorial). F. T. TABAYOYONG and F. A. BASILA. *Sugar News* (Philippines) 1957, **33**, 644–650.—The results of a complex field experiment are set out in great tabular detail, and varietal and fertilizer recommendations are given by which the planter, under the conditions of the experiment, can secure the greatest return measured as yield of cane or sugar.

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Sugar Cane Research in Queensland. N. J. KING. *Sugar J.* (La), 1958, **20**, (9), 4–7.—A brief general survey of the problems facing the Queensland Experiment Stations.

Successful Demonstration of Self-Loading Trailers. ANON. *S. African Sugar J.*, 1958, **42**, 113–127.—At the demonstration, organized by the Zululand Cane Mechanization Committee, the trailers exhibited included the Evans, Benada, Upfold, Perry, and Bell. Comments are given on all these, and the Perry, Evans, and Upfold are described in greater detail with accompanying illustration.

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Soil Fertility Increased by Trash Blanketing and Fertilizers. ANON. *S. African Sugar J.*, 1958, **42**, 129–133.—The article is the sixth of the series on Agricultural Practices published in collaboration with the Experiment Station, South African Sugar Association, and describes the system of trash blanketing practised on the Jex Estates. The stages in the development from trash burning were: alternate line trashing, composting trash and manure at the field side, leaving a thick blanket of trash and, ultimately, top-dressing this blanket with fertilizer basically 600 lb G mixture (6:10:3) plus 200–300 lb sulphate of ammonia. The soil fertility thus built up admits up to 4 or 5 ratoon crops. The position now reached is that up to 100 tons per acre in a two year crop may be produced and present varieties cannot stand up to the weight. The alternatives are the production of varieties less liable to lodge or an annual harvest.

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Weather Modification in the Tropics. H. R. SHAW. *Sugar y Azúcar*, 1958, **53**, (4), 36–39.—An account is given of the pioneer effort made to increase rainfall in the cane growing tracts of Guadeloupe by seeding the upper air with silver iodide from ground-based furnaces. The results obtained in 1955 and 1956 are very promising.

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Cytological Studies in *Saccharum* and allied genera. IV. Hybrids from *S. officinarum* (2n=80) × *S. spontaneum* (2n=96). S. PRICE. *J. Hered.* 1957, **48**, 141–45; through *Plant Breeding Abstracts*, 1958, **28**, 1912.—Progeny from the above crops were found to be either 2n + n, with 128 chromosomes or n + n, with 88 chromosomes. In the former group the maximum degree of pairing during meiosis was $63_{II} + 2_{I}$ and in the latter 44_{II}, with no evidence of synaptic association between the chromosomes of the two parents in either case. Autosyndesis in the hybrid indicates that the gametic chromosomes of *S. officinarum* 'Caña Blanca' consist of two groups of 20 and those of *S. spontaneum* "Mandalay" of two groups of 24. It is suggested that the basic chromosome number in *S. officinarum* is 10 and that in *S. spontaneum* is 12 or, more probably, 8.

ICUMSA

President : H. C. S. de WHALLEY.

THE Twelfth Session of The International Commission for Uniform Methods of Sugar Analysis was held at Washington, D.C., U.S.A., during the first week of June.

Twenty countries were represented by 99 delegates and many other countries not represented by delegates had contributed to the production of Referee Reports. Sunday evening was given over firstly to a meeting of the Executive Committee, followed by a coffee hour for all delegates and their ladies to meet. The *Opening Session* and business meeting was held at the *National Bureau of Standards* by kind permission of Dr. A. V. ASTIN, the Director of the Bureau, who attended and gave an address of welcome and continued with an interesting account of the work of the Bureau. He was accompanied by Dr. E. WICHERS, the Associate Director for Chemistry, who spoke on the early and continued association of the Bureau with ICUMSA coupled with the name of the Life Honorary President, Dr. FREDERICK BATES, who was present throughout the whole session.

Chairman of the opening meeting was Dr. G. P. MEADE who was Chairman of the hosts, the United States National Committee for Sugar Analysis. He called on the President Mr. H. C. S. DE WHALLEY to speak. The latter thanked Dr. ASTIN and Dr. WICHERS for their attendance at the meeting and for their words of welcome and interest. Their permission to open the Session at the Bureau had lent lustre to ICUMSA. Thanks were also offered to the U.S. Committee for their invitation to Washington and the donations from the Sugar Research Foundation and the Corn Industries Association to finance the meeting and social gatherings and expeditions.

The comprehensive and able programme of work and pleasure had been organised by Mr. and Mrs. CARL SNYDER and Miss SNYDER and a willing team to all of whom especial thanks were due.

Many letters and cables had been sent to Washington from overseas delegates unable to attend, all expressing their good wishes for a successful meeting. These included Vice Presidents M. DELACROIX (Belgium) Prof. J. DUBOURG (France), Mr. O. WIKLUND (Sweden), Dr. BRIEGHEL-MÜLLER (Denmark), Dr. K. SANDERA (Czechoslovakia), Dr. ANCÍZAR SORDO (Colombia), Life Hon. Vice President Mr. L. EYNON (Great Britain) and the Chairman of the Netherlands Committee, Mr. C. J. ASSELBERGS. A cable was also received from Cuba announcing the formation of a Cuban Committee.

Since the Paris Session ICUMSA had lost several well known figures who had contributed largely to the past work of the Commission, Dr. F. W. ZERBAN, Mr. J. BROWN and Mr. W. M. SEABER. Silent tribute was paid to their memory.

The President then appointed the following Committees :

Nominations Committee —GORDON MAYBEE (Canada) Chairman; GEORGE P. MEADE (U.S.A.); A. CARRUTHERS (G.B.); H. I. WATERMAN (Holland).

Credentials Committee.—H. B. HASS (U.S.A.) Chairman; R. SAUNIER (France); R. POL (Puerto Rico); F. SCHNEIDER (Germany).

Publications Committee.—D. GROSS (G.B.), Chairman; C. SNYDER (U.S.A.); H. HIRSCHMÜLLER (Germany); R. A. MCGINNIS (U.S.A.); H. C. S. DE WHALLEY (G.B.).

The meeting then adjourned for the Committees to prepare their Reports. The following announcements were made by the Chairmen :

Nominations Committee

Re-nomination of President & Officers, viz.

President: H. C. S. DE WHALLEY.

Secretary: D. GROSS

Treasurer: T. R. GILLETT

Vice-Presidents: J. ANCÍZAR-SORDO (Colombia), who had resigned following his change of occupation, to be replaced by R. POL (Puerto Rico). The remaining Vice-Presidents were re-nominated: A. BRIEGHEL-MÜLLER (Denmark), J. DELACROIX (Belgium), J. DUBOURG (France), H. HIRSCHMÜLLER (Germany), G. R. MAYBEE (Canada), G. P. MEADE (U.S.A.), K. SANDERA (Czechoslovakia), O. WIKLUND (Sweden). To this list was added C. J. ASSELBERGS (Holland).

At the business meeting at the conclusion of the session all nominees were unanimously elected.

Credentials Committee

National Committees represented at the meeting in Washington:

	Votes	*Voting Delegates*
Australia & Fiji	4	R. W. RUTLEDGE (4)
British West Indies	1	W. S. WISE
Canada	2	G. R. MAYBEE, G. R. MCCONNELL
Cuba	4	—
France	4	R. SAUNIER (4)
Germany	4	H. HIRSCHMÜLLER (2) R. WEIDENHAGEN F. SCHNEIDER
Great Britain	4	A. CARRUTHERS H. E. C. POWERS J. G. N. GASKIN J. H. DEFRATES
Hawaii	1	L. J. RHODES
Holland	1	H. I. WATERMAN
Japan	1	T. YAMANE
Mauritius	1	J. DUPONT DE R. ST. ANTOINE
Puerto Rico	1	R. POL
South Africa	2	K. DOUWES DEKKER J. B. ALEXANDER
Taiwan	1	C. WU
U.S.A.	4	G. P. MEADE C. F. SNYDER H. B. HASS T. R. GILLETT

Publications Committee

The members nominated all agreed to serve. The Executive Committee meeting had decided to publish proceedings in England and as customary in English, translations into French and German to be made by arrangements with National Committees in those countries. Abstracts of Reports together with Referee and meeting recommendations and decisions would be prepared by Secretary D. GROSS and published at an early date in the *International Sugar Journal.*

Treasurers Report

Mr. T. GILLETT stated only the balance of funds remaining as the full report would be presented in the Proceedings. Total balance in U.S. and British Accounts $1,495·28 or approximately £534 sterling.

The contributions from National Committees was fixed by the Executive Committee at £15 per unit and will be called in by the Treasurer in January 1959. No contribution is due from attending observers.

Final Announcement.

It was agreed to hold the 13th Session in Berlin in 1962 at the kind invitation of the German National Committee.

Shoreham Hotel

The remainder of the session was held here for the following four days and the Referee Reports on the subjects of the Agenda were presented. It was generally considered to be a most successful meeting with high level reports and discussions.

Social arrangements

These included sight-seeing trips in and around Washington, especially for the ladies. The visits included Mount Vernon, Smithsonian Institution, Freer Gallery, a major league baseball game in the Griffith Stadium and a cocktail party and dinner in the Shoreham Hotel, attended by the official representatives of the National Bureau of Standards and their ladies, at which, among others, Dr. BATES gave a highly amusing account of the early history of ICUMSA.

THE DETERMINATION OF CALCIUM AND MAGNESIUM IN CANE JUICE

By M. C. BENNETT and N. O. SCHMIDT

(Dept. of Sugar Chemistry and Technology, Imperial College of Tropical Agriculture, Trinidad, B.W.I.).

Paper presented to the B.W.I. Sugar Technologists' Association, 1957.

Introduction

THE juice expressed from sugar cane by crushing in a mill is a heterogeneous suspension of particles in the 1–10μ diameter range, and the particle density may be as great as 10^9 particles per ml[1]. Calcium and magnesium exist not only in solution in the continuous phase both as free hydrated cations and as complexes with organic constituents, such as hydroxy- and amino-acids, protein and polysaccharide, but also bound at the surface of the suspended particles by adsorbed protein[2]. The total concentration of calcium and magnesium generally lies between 5 and 30 mM.

The accurate determination of calcium and magnesium, either separately or together, by the Schwarzenbach method, which uses titration with ethylenediaminetetraacetic acid (EDTA) and such indicators as Eriochrome Black T (ET)[3] or murexide (Mx)[4] requires that equilibrium is established rapidly in order that a sharp endpoint may be detected. In cane juice, however, the titration must involve not only the equilibration of metals between their various complexes in true solution but also the very much slower exchange of metals between the dissolved and adsorbed state; indeed, a drifting end point is a feature of all direct juice titrations. Furthermore, the accurate determination requires that the total quantity of the calcium or magnesium must be included in, and all other ions excluded from, the EDTA titration.

For these reasons it is clearly desirable to remove the suspended solid phase first in such a manner that all the calcium and magnesium remain in true solution, and then remove the interferences caused by any other juice constituent remaining in the system. It is the purpose of the present work to describe the means by which the conditions necessary for accurate determination of calcium and magnesium may be established.

[1] BENNETT: *I.S.J.*, 1957, **59**, 176, 208.
[2] BENNETT: *J. Colloid Sci.*, 1957, **12**, 434.
[3] BIEDERMANN and SCHWARZENBACH: *Chimia*, 1948, **2**, 56.
[4] SCHWARZENBACH and GYSLING: *Helv. Chim. Acta*, 1949, **32**, 1314.

Conditions for Accurate Determination of Calcium and Magnesium

(1) *Clarification.*—A study of the effect of pH on the extent of cation binding by protein adsorbed at the surface of suspended particles has shown that below pH 1 all metal cations are released from the particle surface[5]. If a surplus of a strongly complexed cation, e.g. ferric ion, is now added to the system and the pH raised, it will be the ferric ions which are readsorbed, leaving the total quantity of released calcium and magnesium in solution. Furthermore, excess ferric ions are precipitated at pH values greater than 3 as ferric phosphate or ferric hydroxide, and the dispersed particles are carried out of free suspension in a manner similar to that described for calcium phosphate clarifications[1].

The removal of inorganic phosphate from the juice sample is a desirable feature of the "iron-clarification", for this prevents precipitation of calcium and magnesium phosphates under the alkaline conditions used for EDTA titration. The extent of phosphate removal depends on both the amount of ferric ions added and the final clarification pH; results obtained show that the optimum pH lies between 4 and 5 and that ferric ions must be added to the juice to give not less than 40 mM final concentration. Determinations of the calcium content of the filtrate from the iron clarification at various pH values showed that some calcium phosphate was precipitated at values above pH 5·5, thereby defeating the object of the clarification. The final pH is therefore important, and in the experimental details given below the use of an acetate buffer at pH 4·5 is recommended.

(2) *Interference due to other cations.*—Interfering cations are those which are included in the EDTA titration of calcium and magnesium or which form such strong complexes with the indicator used that they affect the colour change at the titration end-point. The total concentration of such cations in cane juice rarely exceeds 5 mM, the only important ions being iron, aluminium and manganese[6].

It is well established that the interference due to iron, whether in the ferrous or ferric state, in the EDTA titration is completely removed by the addition of a large excess of cyanide.

In a similar manner the addition of excess triethanolamine[7] removes the interference caused by aluminium, but it must be pointed out that aluminium is almost completely precipitated during the iron-clarification described.

In all juices which we have experienced, manganese occurs in sufficient quantity to interfere with the colour change of the indicator. This interference is due to the presence of manganic ions, and may be overcome, as is well known, by the addition of hydroxylamine which reduces manganic to the manganous state. However, manganous ions are included in the EDTA titration of calcium and magnesium, and must therefore be removed from the system before the titration is performed.

Manganese may be removed by the addition of diethyldithiocarbamate (DDC)[8] which forms a complex with the metal. This complex is only sparingly soluble in aqueous media and may be extracted from the solution with organic solvents such as chloroform, carbon tetrachloride or amyl alcohol. It may be noted that, in a similar manner, DDC treatment followed by solvent extraction will also remove many other metals and notably iron.

In practice, it was found that the addition of DDC to the filtrate from the iron-clarification yielded a black precipitate of the iron-DDC complex which was more conveniently filtered off than removed by solvent extraction. Investigation into the optimum conditions for removal of manganese showed that complete manganese removal was best effected in slightly alkaline media. In the experimental technique adopted, the DDC is added as its sodium salt (which gives an alkaline reaction in aqueous media), and the quantities of the reagents have been so arranged that after DDC treatment and solvent extraction a solution of about pH 8 is obtained which is completely free from both iron and manganese.

(3) *Separate determination of calcium and magnesium.*—A direct determination of the calcium content of the filtrate obtained after DDC treatment may be carried out by EDTA titration using Mx indicator. Magnesium may be determined separately after precipitation and separation of all calcium present as its oxalate. The EDTA titration is carried out using ET indicator, though in order to obtain a sharp end point the oxalate content of the filtrate must not be too large[9].

Experimental

Cane Juice

Sugar cane stalks were crushed in a laboratory three-roller mill and the extracted juice filtered through cotton wool. Any additions of known quantities of Ca^{2+}, Mg^{2+} and Mn^{2+} were made at this stage, while $FeCl_3$ was added in the clarification process.

Ashing

100 ml of juice in a silica basin were evaporated to dryness in an oven at 105–110°C. The drying was continued for 24 hr, gradually raising the temperature to 150°C, and the ashing finally carried out in a muffle-furnace at 400°C. The ash obtained was moistened with 10 ml conc. HCl and evaporated to dryness, this process then being repeated. Finally, 5 ml 4N HCl and 25 ml distilled water were added to the evaporated sample in the basin, the contents heated and then transferred to a beaker, the transfer being completed by successive washings with boiling water until a total volume of about 100 ml solution was obtained.

[5] Bennett: *Chem. and Ind.*, 1957, 1098.
[6] Honig: "Principles of Sugar Technology" (Elsevier, Amsterdam), 1953, p. 292.
[7] Pribyl: *Coll. Czech. Chem. Comm.*, 1954, **19**, (3), 465.
[8] Cheng *et al.*: *Soil Sci.*, 1953, **75**, 37.
[9] Banewicz and Kenner: *Anal. Chem.*, 1952, **24**, 1186.

Iron Clarification

5 ml of 4N HCl were added to 100 ml of juice (or the approx. 100 ml of ash solution), followed by 10 ml of 0·5 M $FeCl_3$. After 2–3 minutes the system was adjusted to between pH 4 and 5 with 6N NaOH and 1 ml of M acetate buffer (pH 4·5) added. The solution was then made up to 200 ml in a volumetric flask and filtered through Whatman No. 1 paper.

DDC Treatment

To about 100 ml of the iron-clarified filtrate was added about 100 mg of the solid sodium salt of DDC and, after shaking, the black precipitate formed was removed by filtration through Whatman No. 1 paper into a clean dry flask. Another approx. 100 mg of DDC was added, 10 ml of chloroform introduced into the flask and the contents shaken vigorously, the presence of manganese being detected as a purple coloration of the chloroform layer. When, on standing, the two liquids had separated completely, the aqueous layer was decanted off and the DDC addition followed by chloroform extraction repeated until the chloroform layer remained colourless or faintly yellow. Generally this required only one or two more additions, after which it was found that the aqueous solution had a pH value of about 8.

Calcium Oxalate Precipitation

50 ml of the DDC treatment filtrate were pipetted into a 100 ml volumetric flask and 10 ml of 0·2 M sodium oxalate at pH 5·0 added. The contents were then made up to 100 ml and allowed to stand for at least 2 hours. The calcium oxalate precipitate was separated off by centrifuging for about 20 minutes at 1000 *g*.

Titration Methods

(A) Titration of DDC-treated filtrates for combined $Ca^{2+} + Mg^{2+}$ and titration of oxalate filtrates for Mg^{2+}.

50 ml of distilled water, 5 ml of 1·5 M ammonia–ammonium chloride buffer at pH 10·3, 1–2 drops of 10 mM $MgCl_2$ and 8 drops of ET indicator (0·2% ethanol solution) were adjusted to the end point with a few drops of the standard 10 mM EDTA solution. The sample was then pipetted in and titrated against EDTA. Fading of the indicator colour generally indicated that iron or manganese had not been completely removed from the solution.

(B) Titration of DDC-treated filtrates for Ca^{2+}.

The sample was pipetted into 50 ml of distilled water, and 2 ml of 6N NaOH and about 150 mg Mx indicator (0·1 g Murexide mixed with 35 g NaCl in a mortar) were added. The solution was then titrated against the standard EDTA, though it must be noted that, since the end point was not particularly sharp, it was found desirable to have a comparison flask nearby.

Results and Discussion

In Table I are shown the results of titrations carried out on ten cane juice samples after the treatments which have been suggested and described above. Each treatment was carried out in duplicate and the results given below are the means of determinations on each pair of duplicate solutions.

Table I
Calcium and Magnesium Determination on Cane Juice

Juice Sample.	mM Ca & Mg without ashing	mM Ca & Mg via ash	mM Ca without ashing	mM Ca via ash	mM Mg without ashing	mM Mg via ash
1....	14·14	13·97	6·00	6·02	8·08	8·00
2....	12·27	12·24	6·72	6·70	5·56	5·58
3....	24·15	24·06	10·26	10·10	13·96	14·12
4....	14·88	14·51	7·42	7·20	7·48	7·38
5....	10·07	10·23	4·85	4·75	5·39	5·48
6....	20·22	20·11	12·35	12·33	7·89	7·77
7....	13·53	13·32	7·32	7·20	6·26	6·23
8....	18·60	18·52	8·30	8·28	10·42	10·36
9....	21·62	21·96	8·63	8·70	12·92	13·02
10....	14·40	14·31	6·89	6·74	7·44	7·30
Means	16·39	16·32	7·87	7·80	8·54	8·52

The reproducibility of titrations of the same solution using ET indicator was within 0·05 mM, while using Mx indicator the reproducibility was within 0·10 mM. A measure of the reproducibility of each result shown in Table I can be obtained from the standard deviation calculated from the duplicated determinations:—

Using ET indicator, solutions prepared from juice: standard deviation = 0·10 mM

Using ET indicator, solutions prepared via ash: standard deviation = 0·15 mM

Using Mx indicator, solutions prepared directly or via ash: standard deviation = 0·15 mM

The DDC treatment and oxalate precipitation did not increase these standard deviations.

In Table I each result obtained from a solution prepared directly from the cane juice is compared with that from a solution prepared via the ash of the same juice. The excellent agreement between "direct" and "via ash" determinations shows that the organic constituents of cane juice do not at any stage interfere in the determination of calcium and magnesium, and it may be concluded that calcium and magnesium do not form an intrinsic part of the particles originally present in raw juice. It is also seen that, because of the increase in the standard deviation, the accuracy of an individual determination is, in fact, decreased by the inclusion of the ashing operation.

Table II shows the results of titrations of solutions prepared from five cane juices to which were made additions of calcium, magnesium and manganese. Each figure is the mean of determinations on a pair of duplicate solutions. It is seen that when known additions of calcium and magnesium are made to the juice, the expected concentrations of both total and individual cations are determined by the methods proposed. Furthermore, as seen from both Tables I and II, the sum of the individually determined calcium and magnesium is in excellent agreement

Table II. Recovery of Ca and Mg added to Juice Samples.

Juice Sample No.	Cations added			Juice Samples + Ca, Mg, Mn and Fe					
				mM Ca + Mg		mM Ca		mM Mg	
	mM Ca	mM Mg	mM Mn	Expected	Found	Expected	Found	Expected	Found
1	5·05	4·90	2·28	24·09	24·08	11·05	11·30	12·98	12·97
1	10·10	9·79	2·28	34·03	34·14	16·10	16·01	17·87	17·81
3	5·05	14·69	2·28	43·89	43·85	15·31	15·30	28·66	28·43
3	15·16	4·90	2·28	44·21	44·02	25·42	25·09	18·87	19·14
5	—	9·79	1·14	19·86	20·08	4·85	4·85	15·18	15·22
5	—	19·58	1·14	29·65	29·78	4·85	4·77	24·87	24·99
7	—	9·79	1·14	23·32	23·05	7·32	7·33	16·05	15·93
7	—	19·58	1·14	33·11	33·11	7·32	7·50	25·84	25·72
9	10·10	—	1·14	31·72	31·98	18·74	19·10	12·92	13·09
9	20·21	—	1·14	41·83	41·83	28·85	28·53	12·92	13·19
Means	6·57	9·30	1·60	32·57	32·59	13·98	13·98	18·62	18 65

Table III

Value of K for various concentrations and temperatures when $b = 4478°K$

C	45			60			65			70		
t_s	D	NBS	eq. 6	D	NBS	eq. 6	D	NBS	eq. 6	D	NBS	eq. 6
60.....	0·022	0·021	0·022	0·045	0·045	0·046	0·059	0·059	0·059	0·077	0·078	0·077
65.....	0·022	0·022	0·023	0·045	0·046	0·046	0·059	0·059	0·059	0·077	0·078	0·078
70.....	0·022	0·022	0·023	0·045	0·046	0·046	0·058	0·060	0·059	0·077	0·079	0·078
75.....	0·023	0·022	0·023	0·045	0·046	0·046	0·063	0·060	0·059	0·077	0·079	0·078
80.....	0·023	0·022	0·023	0·045	0·046	0·046	0·059	0·060	0·059	0·077	0·079	0·078
85.....	0·022	0·023	0·023	0·045	0·047	0·046	0·058	0·061	0·059	0·077	0·080	0·078
90.....	0·023	0·022	0·023	0·045	0·047	0·046	0·059	0·061	0·059	0·077	0·080	0·078
95.....	0·023	0·022	0·023	0·045	0·047	0·046	0·059	0·061	0·059	0·077	0·080	0·080
100.....	—	0·022	0·023	—	0·047	0·046	—	0·061	0·059	—	0·081	0·078
105.....	—	0·022	0·023	—	0·048	0·046	—	0·062	0·060	—	0·081	0·078
110.....	—	0·023	0·023	—	0·048	0·047	—	0·062	0·060	—	0·082	0·078
115.....	—	0·023	0·023	—	0·048	0·047	—	0·063	0·060	—	0·082	0·078
120.....	—	0·023	0·024	—	0·049	0·047	—	0·063	0·060	—	0·083	0·078
125.....	—	0·023	0·024	—	0·049	0·047	—	0·063	0·060	—	0·083	0·079
130.....	—	0·023	0·024	—	0·049	0·047	—	0·064	0·060	—	0·084	0·079

C	75			80			85			90		
t_s	D	NBS	eq. 6	D	NBS	eq. 6	D	NBS	eq. 6	D	NBS	eq. 6
60.....	0·104	0·103	0·105	0·147	—	0·147	0·218	—	0·218	0·349	—	0·348
65.....	0·104	0·104	0·105	0·146	—	0·147	0·217	—	0·218	0·347	—	0·347
70.....	0·104	0·104	0·105	0·146	—	0·147	0·216	—	0·217	0·346	—	0·346
75.....	0·104	0·105	0·105	0·146	—	0·146	0·216	—	0·217	0·344	—	0·344
80.....	0·104	0·105	0·104	0·145	—	0·146	0·215	—	0·216	0·343	—	0·343
85.....	0·104	0·106	0·104	0·145	0·143	0·146	0·214	—	0·216	0·341	—	0·342
90.....	0·104	0·106	0·105	0·145	0·144	0·146	0·214	—	0·215	0·340	—	0·341
95.....	0·104	0·107	0·105	0·145	0·145	0·146	0·213	—	0·215	0·339	—	0·340
100.....	—	0·108	0·105	—	0·146	0·146	—	—	0·215	—	—	0·339
105.....	—	0·108	0·105	—	0·146	0·146	—	—	0·214	—	—	—
110.....	—	0·109	0·105	—	0·147	0·146	—	0·203	0·214	—	—	—
115.....	—	0·109	0·105	—	0·148	0·146	—	0·204	0·214	—	0·285	—
120.....	—	0·110	0·105	—	0·149	0·146	—	0·205	0·214	—	0·287	—
125.....	—	0·110	0·105	—	0·149	0·146	—	0·206	0·214	—	0·288	—
130.....	—	0·111	0·106	—	0·150	0·146	—	0·207	0·214	—	0·289	—

with the independently determined value for calcium and magnesium together, and hence knowledge of the total concentration of both cations and the concentration of either one allows the determination of the other by difference.

Table II also shows that the interference due to manganese and iron has been completely eliminated in the determination of calcium and magnesium.

Since the end point of the calcium titration is rather difficult to observe when Mx is used as the indicator, the solutions used in the above experiment were also titrated for calcium in the presence of magnesium using 2-hydroxy-1-(2 hydroxy-4-sulpho-1-naphthylazo)-3-naphthoic acid (HNA) as the indicator[10]. It was found that the colour change of this indicator was more readily detected, but, in spite of this, the reproducibility of titrations of the same solution was not improved. The results showed that the two indicators gave similar values when the titration was performed on a sample prepared via the ash, but on the samples prepared directly from the cane juice the HNA titration gave a significantly higher value (of the order of 0·5 mM). From these and other experiments it seems likely that the organic constituents of raw juice interfere in the titration when HNA indicator is used.

[10] PATTON and REEDER: *Anal. Chem.*, 1956, **28**, 1026.

Concluding Observations

In the various methods[11,12] which have been put forward for the determination of calcium and magnesium in juices, the juice sample is clarified prior to titration, but it is to be expected that particle-bound Ca^{2+} and Mg^{2+} will be removed by the precipitation or filtration processes suggested. Furthermore, these methods do not take into account the manganese content of the juice, though in most juices this is low and therefore gives rise to only a small error.

In the present work it has been found that if the manganese content may be neglected there is, in fact, no need to clarify the juice sample prior to titration of the combined calcium and magnesium content, for a satisfactory determination (in error only by the amount of manganese present) may be carried out by back-titration.

Back-titration method for combined calcium and magnesium (including manganese) in cane juice.

50 ml of distilled water, 2 ml of 1·5 M ammonia buffer (pH 10·3), 2 ml of 1·5 M KCN and 3 drops of 5% hydroxylamine hydrochloride were mixed in the titrating flask, and the sample of raw juice (e.g. 5 ml) pipetted in. Excess standard 10 mM EDTA (e.g. 10–15 ml) was run into the flask and the contents allowed to stand for 5 minutes. Eight drops of ET indicator were added and the surplus EDTA titrated against standard $MgCl_2$ until the end point had been just passed (colour change from green to red). The titration was completed by dropwise addition of EDTA until the green colour was just restored permanently. It was necessary to check the Ca^{2+} and Mg^{2+} content of the reagents used by carrying out a blank determination.

Manganese was included quantitatively, provided that the final dropwise addition of EDTA was carried out slowly. With manganese concentrations up to 0·6 mM the end point was achieved within 5 minutes; with 2 mM concentrations the final adjustment required 15 minutes.

In Table III are shown the various values for the average calcium and magnesium content of ten cane juices as determined in duplicate by a number of different methods.

Table III

Comparison of Different Methods for Ca^{2+} and Mg^{2+}

Clarification.	Ions titrated.	Total concn. determined (mM)
None	Ca^{2+} + Mg^{2+} + Mn^{2+}	16·63
$FeCl_3$	Ca^{2+} + Mg^{2+} + Mn^{2+}	16·61
$FeCl_3$ + DDC treatment (Table I)	Ca^{2+} + Mg^{2+}	16·39
Horne's dry lead (after Parrish[11]) ..	Ca^{2+} + Mg^{2+}	16·09
Kieselguhr filtration (after Honig[12])....	Ca^{2+} + Mg^{2+} + Mn^{2+}	16·48

Table III shows again that the iron clarification method used does not reduce the combined calcium, magnesium and manganese content of the juice, and also shows that the average manganese content was about 0·2 mM. This figure is in good agreement with that determined spectrophotometrically on the same ten juices as 0·22 mM. The filtrate obtained from the Horne's dry lead clarification was, in this work, de-leaded with potassium chromate in acetate buffer (pH 4·5), and it was shown that manganese had been completely removed from the system. It is seen that the calcium and magnesium content is about 2% lower than that determined by the accurate method described above, and the loss is undoubtedly that of particle-bound cations. The value of 2% is in accordance with that expected from calcium adsorption studies[3]. In the case of the kieselguhr filtration, this was carried out in acetic acid at pH approx. 3 where cation adsorption at the particle surface is much weaker, and hence the loss of particle-bound cations is reduced. It may be pointed out that the use of acid-washed filter-aids is to be avoided for we have shown that some of the calcium eluted from either charcoal or kieselguhr by acid is readsorbed on placing these materials in calcium-containing solutions.

It is clear from Table III that the back-titration method offers a very rapid and quite accurate determination of the combined calcium and magnesium content of juices low in manganese.

When rapid separate determinations of the individual cations in such juices are required, it is unfortunately still necessary to iron-clarify the raw juice sample, for our experiments have shown that it is not possible to precipitate calcium quantitatively from untreated raw juice: not only is the precipitate difficult to separate, but the magnesium values obtained depend upon the initial calcium concentration. However, the DDC treatment may be omitted and titrations performed directly on the iron-clarified filtrate.

Titration of Ca^{2+} in clarified juices containing iron and manganese.

As titration method (B) (see under Experimental), but with 5 drops of hydroxylamine and 5 ml of 30% aqueous triethanolamine present in the titration flask.

Titration of Mg^{2+} (after calcium oxalate removal) or Ca^{2+} + Mg^{2+} in clarified juice containing iron and manganese.

50 ml of distilled water, 5 ml of 1·5 M ammonia buffer pH 10·3, 5 ml of 1·5 M KCN, 3 drops of 5% hydroxylamine hydrochloride, 2 drops of 10 mM $MgCl_2$ and 8 drops of ET indicator solution are adjusted to the end point with a few drops of EDTA. The sample is pipetted in and titrated against standard EDTA. Manganese is included in this titration, but since the exchange of manganese between cyanide and EDTA is a slow process, the titration end point must be approached slowly. When the manganese content is above about 0·2 mM the time necessary to complete the titration may be reduced by heating the solution to 60–80°C.

[11] Parrish: *Proc. 8th Congr. ISSCT*, 1953, 742.
[12] Honig: *Rpts. W. Indies Sugar Corp.*, 1952, (2),

It is clear from the above that the choice of method for calcium and manganese determination will depend on both the accuracy required and the manganese content of the cane juice. The methods presented here for both the accurate and rapid approximate determination of calcium and magnesium in cane juices have general applicability not only to sugar-house products, but also to many other biological fluids.

ACKNOWLEDGMENT

This work forms part of a programme of research carried out by the B.W.I. Sugar Research Scheme. The authors would like to thank Mr. J. SPECTOR for the spectrophotometric manganese determinations.

BRITISH SUGAR CORPORATION LTD.

11th TECHNICAL CONFERENCE.

THE 11th Technical Conference of the British Sugar Corporation Ltd. was held at the Grand Hotel, Folkestone, Kent, during the 24th to 26th June, 1958. Of the 80 participants, no less than 32 were overseas visitors from places as far apart as Vienna and Denver, Colorado. In addition to the British Sugar Corporation technical staff, representatives of Tate and Lyle Ltd., Westburn Sugar Refinery Ltd. and *The International Sugar Journal* were present.

The Conference was opened on the 24th of June by J. CAMPBELL MACDONALD, O.B.E., Chief Technical Officer and a Director of the Corporation, who, after welcoming the guests, reviewed the achievements of the Corporation over the past campaign, comparing them with previous results. Crop prospects in their respective countries were summarized by overseas visitors, and generally seemed to presage an excellent European campaign with large throughputs.

The first paper, read by Dr. A. CARRUTHERS and associates from the British Sugar Corporation Research Laboratory, dealt with nitrate reduction by thermophilic bacteria in sugar beet diffusion systems, the importance of which had hitherto been unsuspected in relation to sulphur losses.

Prof. Dr. J. DEDEK next discussed the "technical value" of the beet which, he proposed, should be classified by a systematic tabulation of the tangible properties and qualities of beets and their juices, etc., in order to develop criteria for selection in breeding work, improve processing techniques, etc. A more detailed account of crop prospects in the U.K. was given by G. F. N. BATTLE, C.B.E., Executive Director of the Corporation and this was followed by a colour documentary film which had met with a distinguished reception at the recent Cannes Film Festival and was devoted to the photosynthesis and metabolism of sucrose in plants and animals. It was made in collaboration with the Institut für Zuckerindustrie in Berlin and was presented with a commentary by the Director of the Institute, Prof. H. HIRSCHMÜLLER.

Aspects of low grade massecuite handling were discussed separately by O. H. PHIPPS of the British Sugar Corporation and F. M. CHAPMAN of Tate & Lyle, while H. E. C. POWERS described his latest work on the "inclusions" of foreign matter held within the sugar crystal. Dr. L. KAYSER gave a brief account of the first campaign in the Rain-am-Lech factory described at the 10th Conference.

On the following day, a further paper by Dr. CARRUTHERS and his staff on the chemistry of sulphitation was concerned with the analysis and investigation of the origin of iminodisulphonic acid in beet juices, tracing its connexion with the nitrite present as a result of the bacterial action referred to in their previous paper. R. J. M. WITHERS, Control Development Engineer of the Corporation, then described a number of instruments and equipment for use in measurement and control of certain variables of importance in beet sugar manufacture. Following lunch, a coach tour was arranged to visit Rye, an ancient town which was one of the Cinque Ports and contains buildings dating from the 15th century.

The Conference dinner in the evening was followed by a return to work the next morning, when B. S. BROOKS, P. SCOTT and R. J. M. WITHERS described their investigations into the performance of the pulp driers at Spalding factory. K. HAMPEL, Deputy Chief Technical Officer, provided his usual detailed study of heat usage and power in the factories of the Corporation, with a mass of data collected in the form of a booklet which drew forth praise in the discussion of his paper as a most remarkable account of the performance of the factories to be made available by the Corporation.

The Conference once again provided a valuable exchange of information between delegates and the British Sugar Corporation are to be congratulated on their remarkable achievement in bringing together the distinguished technologists of the beet sugar industry and on the high standard of the papers read. It is intended to publish summaries of the papers in forthcoming issues of this Journal, and we acknowledge with thanks the permission to do this.

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A FORMULA FOR CALCULATING EFFICENCY OF THE IMBIBITION PROCESS

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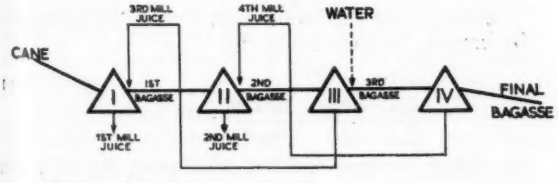
THE working of a milling plant, as a whole, is indicated by the value of milling efficiency, mill performance, or even by the value of undiluted juice lost % fibre. When milling efficiency is low, however, it becomes necessary to examine the working of individual milling units. Mill settings are generally taken as the controlling factor and stress is laid upon their testing and adjustment. The imbibition process is seldom checked for its efficiency. This is, in fact, due to the lack of a formula by which it is possible to find out the amount of water or thin juice of that added which has actually diluted the residual juice in bagasse. The process of compound imbibition is a process of countercurrent extraction, and the more the solvent (imbibition liquid) comes into contact with the solute (residual juice in bagasse), the greater is the extraction. Hence the milling efficiency depends directly upon the efficiency of the imbibition process. It is, therefore, felt that a formula by which calculations of the imbibition process efficiency can be made is urgently needed in order to check and improve the technique of imbibition. The term Efficiency of Imbibition is defined as: "the amount of imbibition liquid (water or thin juice) actually effecting the dilution of residual juice in bagasse from the preceding mill expressed as a percentage of imbibition liquid added".

Derivation of the Formula

Let us first consider a tandem consisting of twelve rollers (four mills of three rollers each). The process of imbibition under consideration is compound. The arrangement is shown in the figure below:—



Assuming that:—

Brix of first mill juice or primary juice $= B_1$
Brix of second mill juice $= B_2$
Brix of third mill juice $= B_3$
Brix of fourth mill juice $= B_4$
Residual juice % first bagasse $= m_1$
Residual juice % second bagasse $= m_2$
Residual juice % third bagasse $= m_3$
Residual juice % fourth bagasse $= m_4$
First bagasse % cane $= b_1$
Second bagasse % cane $= b_2$
Third bagasse % cane $= b_3$
Fourth bagasse % cane $= b_4$
Efficiency of imbibition on first bagasse $= X_1$
Efficiency of imbibition on second bagasse $= X_2$
Efficiency of imbibition on third bagasse $= X_3$
Imbibition water added % cane $= W$

and that (1) weight of juice extracted by a secondary mill is equal to the water or thin juice added on bagasse which enters the mill; and (2) the Brix of residual juice in first bagasse is equal to the Brix of juice extracted by the first mill.

Now, juice solids % first bagasse $= \frac{B_1 m_1}{100}$,

juice solids in first bagasse % cane $= \frac{B_1 m_1}{100} \cdot \frac{b_1}{100}$

and water in first bagasse % cane $= \frac{100 - B_1}{100} \cdot \frac{b_1 m_1}{100}$

If only W_1 out of W thin juice expressed by the third mill, added on the first bagasse, has diluted the residual juice in it, then the bagasse entering the second mill presents to it two juices;

(1) $(W_1 + m_1)$ in which solids are:—

$$\frac{B_1 m_1}{100} \cdot \frac{b_1}{100} + \frac{W_1 B_3}{100}$$

and water is $= \frac{100 - B_1}{100} \cdot \frac{b_1 m_1}{100} + \frac{W_1 (100 - B_3)}{100}$

or the Brix of the juice is :

$$\frac{\left(\frac{B_1 m_1}{100} \cdot \frac{b_1}{100} + \frac{W_1 B_3}{100}\right) 100}{\frac{B_1 m_1}{100} \cdot \frac{b_1}{100} + \frac{W_1 B_3}{100} + \frac{100 - B_1}{100} \cdot \frac{m_1 b_1}{100} + \frac{W_1 (100 - B_3)}{100}}$$

or: $\frac{B_1 m_1 b_1 + 100 B_3 W_1}{m_1 b_1 + 100 W_1}$ ..... (1)

let this be represented by B_{1b}.

and (2) $W - W_1$ of Brix B_3.

Considering that the latter juice $(W - W_1)$, being only superficially adhered to the bagasse, is expressed completely by the second mill and that out of the former juice of Brix B_{1b} only W_1 is expressed (since the total juice expressed by the mill is only W — assumption No. 1), the final Brix of the juice W expressed by the second mill would be:—

$$= \frac{\frac{(W - W_1)\,B_2}{100} + \frac{W_1\,B_{1b}}{100}}{\frac{(W-W_1)\,B_2}{100} + \frac{W_1\,B_{1b}}{100} + \frac{(W-W_1)\,(100-B_2)}{100} + \frac{W_1\,(100-B_{1b})}{100}} \times 100$$

or: $= \dfrac{(W-W_1)\,B_2 + W_1\,B_{1b}}{W}$

But the Brix of juice expressed by the second mill is B_2, hence:—

$$B_2 = \frac{(W-W_1)\,B_2 + W_1\,B_{1b}}{W} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Substituting the value of B_{1b} from (1) in (2),

$$B_2 = \frac{1}{W}\left[(W-W_1)\,B_2 + W_1\left(\frac{B_1 b_1 m_1 + 100\,B_2 W_1}{b_1\,m_1 + 100\,W_1}\right)\right] \ldots\ldots (3)$$

On simplification of (3) the following is obtained:—

$$W_1 = \frac{W}{\frac{B_1 - B_2}{B_2 - B_3} - \frac{100\,W}{b_1\,m_1}} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

Since by definition $X_1 = \dfrac{W_1}{W} \times 100 \quad \ldots\ldots\ldots\ldots (5)$

therefore: $X_1 = \dfrac{100}{\frac{B_1 - B_2}{B_2 - B_3} - \frac{100\,W}{b_1\,m_1}} \quad \ldots\ldots\ldots\ldots (6)$

The assumption is made above that the juice $(W - W_1)$ of Brix B_2 which took no part in diluting the residual juice of first bagasse has been expressed completely by the second mill; therefore it can be safely assumed that the Brix of the residual juice in second bagasse is B_{1b}.

Therefore, juice solids % second bagasse $= \dfrac{m_2\,B_{1b}}{100}$

and juice solids in second bagasse % cane $= \dfrac{m_2\,B_{1b}}{100} \cdot \dfrac{b_2}{100}$

Now, if only W_2 out of W thin juice, expressed by the fourth mill, and added on the second bagasse, is effective in diluting the residual juice in this, then the juices presented to the third mill for expression are of the following composition:—

(1) Juice $(W_2 + m_2)$ which contains:

(*a*) solids $= \dfrac{W_2\,B_4}{100} + \dfrac{B_{1b}\,m_2}{100} \cdot \dfrac{b_2}{100}$

and (*b*) water $= \dfrac{W_2\,(100 - B_4)}{100} + \dfrac{(100 - B_{1b})\,m_2}{100} \cdot \dfrac{b_2}{100}$

i.e. the Brix of the juice is

$$\frac{\left(\frac{W_2\,B_4}{100} + \frac{B_{1b}\,m_2}{100} \cdot \frac{b_2}{100}\right) 100}{\frac{W_2\,B_4}{100} + \frac{B_{1b}\,m_2}{100} \cdot \frac{b_2}{100} + \frac{W_2\,(100-B_4)}{100} + \frac{(100-B_{1b})\,m_2}{100} \cdot \frac{b_2}{100}}$$

or $= \dfrac{B_{1b}\,m_2\,b_2 + 100\,B_4\,W_2}{m_2\,b_2 + 100\,W_2} \quad \ldots\ldots\ldots\ldots\ldots (7)$

let this be represented by B_{2b}.

(2) Juice $W - W_2$ of Brix B_4.

For reasoning similar to the above in deriving the equation for X_1, Brix of the juice expressed by the third mill would be:—

$$B_3 = \frac{\left(\frac{(W-W_2)\,B_4}{100} + \frac{W_2\,B_{2b}}{100}\right) \times 100}{\frac{(W-W_2)\,B_4}{100} + \frac{W_2\,B_2}{100} + \frac{(W-W_2)\,(100-B_4)}{100} + \frac{W_2\,(100-B_{2b})}{100}}$$

$$= \frac{(W-W_2)\,B_4 + W_2\,B_{2b}}{W} \quad \ldots\ldots\ldots\ldots (8)$$

Substituting the value of B_{2b} from (7) in (8), we get:—

$$B_3 = \frac{1}{W}\left[(W-W_2)\,B_4 + W_2 \cdot \left(\frac{B_{1b}\,b_2 \cdot m_2 + 100\,B_4\,W_2}{b_2\,m_2 + 100\,W_2}\right)\right]$$

On simplification and readjustment, this yields

$$W_2 = \frac{W}{\frac{B_{1b} - B_4}{B_2 - B_4} - \frac{100\,W}{m_2\,b_2}} \quad \ldots\ldots\ldots\ldots\ldots (9)$$

Since $X_2 = \dfrac{W_2}{W} \times 100$ (by definition)

therefore $X_2 = \dfrac{100}{\frac{B_{1b} - B_4}{B_2 - B_4} - \frac{100\,W}{m_2\,b_2}} \quad \ldots\ldots\ldots\ldots (10)$

Similarly for the fourth mill, if water of imbibition be impure, its Brix being B_w,

$$X_3 = \frac{100}{\frac{B_{2b} - B_w}{B_4 - B_w} - \frac{100\,W}{m_3\,b_3}} \quad \ldots\ldots\ldots\ldots\ldots (11)$$

but where water of imbibition is pure, $B_w = 0$, then

$$X_3 = \frac{100}{\frac{B_{2b}}{B_4} - \frac{100\,W}{m_3\,b_3}} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

Now if a milling tandem consisting of five mills be considered, it will be seen that there is no difference in the derivation of the equations and the expressions obtained for X_1 and X_2 are exactly the same as in the above case. The expression for X_3 would become as follows:—

$$X_3 = \frac{100}{\frac{B_{2b} - B_5}{B_4 - B_5} - \frac{100\,W}{m_3\,b_3}} \quad \ldots\ldots\ldots\ldots\ldots (13)$$

where B_5 is the Brix of 5th mill juice. The expression for X_4, the efficiency of imbibition on fourth bagasse would be

$$X_4 = \frac{100}{\frac{B_{3b} - B_w}{B_5 - B_w} - \frac{100\,W}{m_4\,b_4}} \text{ simplifying to}$$

$$X_4 = \frac{100}{\frac{B_{3b}}{B_5} - \frac{100\,W}{m_4\,b_4}} \text{ where Brix of water } B_w = 0,$$

and m_4 and b_4 are the residual juice per cent 4th bagasse and fourth bagasse per cent cane respectively,

$$B_{3b} = \frac{B_{2b}\,m_3\,b_3 + 100\,B_5\,W_3}{m_3\,b_3 + 100\,W_3}$$

in which $W_3 = \frac{X_3 \times W}{100}$.

If the primary unit of a milling tandem consists of a 2-roller crusher and a 3-roller mill, it does not affect the derivation in any way. The crusher has little to do with the imbibition. Brix of the juice from the first 3-roller mill which bagasse enters unmoistened with imbibition liquid, is to be taken as B_1.

Studying the expressions for X_1, X_2, X_3 and X_4, it is noticeable that there is a similarity in them; and therefore it is possible to generalize the expression for efficiency of imbibition of the bagasse entering the nth secondary mill, as:—

$$X_n = \frac{100}{\frac{B_{n-1b} - B_{n+2}}{B_{n+1} - B_{n+2}} - \frac{100W}{m_n\,b_n}} \quad \ldots\ldots\ldots\ldots\ldots (14)$$

and the Brix of the residual juice in bagasse that leaves the nth secondary mill as:

$$B_{nb} = \frac{B_{(n-1)b}\,m_n\,b_n + 100\,B_{n+2}\,W_n}{m_n\,b_n + 100\,W_n} \quad \ldots\ldots\ldots (15)$$

where $W_n = X_n \times W/100$.

It is to be noted that if (*a*) $n = 1$, B_{n-1b} represents the Brix of first mill juice, i.e. B_1; (*b*) n is the number of bagasse going to the last mill, then $B_{n+2} = B_w$, the Brix of the imbibition water = 0 when this water is Brix-free.

Now, if it be assumed that fibre % bagasse from each mill is the same, then (*a*) bagasse % cane from each mill would be the same, i.e., $b_1 = b_2 = b_3 = b$ = the final bagasse % cane and (*b*) residual juice % bagasse from each mill will also be the same, i.e., $m_1 = m_2 = m_3 = m$ = residual juice % final bagasse; and hence the equations (14) and (15) become

$$X_n = \frac{100}{\frac{B_{(n-1)b} - B_{n+2}}{B_{n+1} - B_{n+2}} - \frac{100\,W}{m\,b}} \quad \ldots\ldots\ldots\ldots (16)$$

and $B_{nb} = \frac{B_{(n-1)b}\,b\,m + 100\,B_{n+2}\,W_n}{b\,m + 100\,W_n} \quad \ldots\ldots\ldots (17)$

A numerical example will make quite clear the use of the formula. Let the number of mills in the tandem be four (one primary and three secondary) and $B_1 = 20{\cdot}0$, $B_2 = 12{\cdot}0$, $B_3 = 7{\cdot}0$, $B_4 = 3$, $W = 15$, $b = 27$, $m = 52$ and $B_w = 0$.

For $n = 1$, Substituting in equation (16)

$$X_1 = \frac{100}{\frac{20 - 7}{12 - 7} - \frac{15 \times 100}{27 \times 52}}$$

or $\mathbf{X_1 = 65{\cdot}29\%}$

for $n = 2$, $W_1 = X_1 \times W/100$
$= 65{\cdot}29 \times 15/100$
$= 9{\cdot}79$

therefore $B_{1b} = \frac{B_1\,b\,m + 100\,B_2\,W_1}{b\,m + 100\,W_1}$
$= \frac{20 \times 27 \times 52 + 100 \times 7 \times 9{\cdot}79}{27 \times 52 + 100 \times 9{\cdot}79}$
$= 14{\cdot}66.$

and substituting in equation (16)

$$X_2 = \frac{100}{\frac{14{\cdot}66 - 3}{7 - 3} - \frac{15 \times 100}{27 \times 52}}$$

$\mathbf{X_2 = 54{\cdot}15\ \%}$

for $n = 3$, $W_2 = X_2 \times W/100$
$= 54{\cdot}15 \times 15/100$
$= 8{\cdot}12$

therefore $B_{2b} = \frac{B_{1b}\,b\,m + 100\,B_4 \times W_2}{b\,m + 100\,W_2}$
$= \frac{14{\cdot}66 \times 27 \times 52 + 100 \times 3 \times 8{\cdot}12}{27 \times 52 + 100 \times 8{\cdot}12}$
$= 10{\cdot}39$

therefore, by substitution:

$$X_3 = \frac{100}{\frac{10{\cdot}39}{3} - \frac{100 \times 15}{27 \times 52}}$$

$\mathbf{X_3 = 41{\cdot}75\%}$

Utility of the Equation.

It is possible to check the working of the imbibition process on different mills individually and thereby its technique can be improved in order to get higher extraction. Best conditions, e.g., temperature of imbibition liquid, its pressure of application etc., can also be determined by the trial and error method. It is believed that the formula finally arrived at for the efficiency of the imbibition process will prove of great value if the results are properly interpreted. A considerable improvement may be brought about in the imbibition technique thereby increasing the milling efficiency.

Acknowledgments.

Thanks are due to Mr. R. N. Vala, Chairman of the Kodinar Khandudyog Khedut Sahakari Mandli Ltd., Kodinar, for his interest in the work and encouragement.

Some Notes on Controlled Seeding. R. D. MOROZ. *Paper presented to the Sugar Industry Technicians Inc.*, 1957 ; through *S.I.A.*, 1957, **19,** Abs. 581.—The theory of full pan seeding is discussed in detail and some experimental results of the iso-kinetic relationships between rates of growth, seed size, temperature and supersaturation are shown in graphs. Criteria of seed quality are discussed in connexion with the selection of a suitable seed production method : seed production by grinding (both primary and secondary seed), nucleation and extended growth of primary seed are also discussed. The method of Appelboom[1] for the production of micro-grain by nucleation, is tentatively supported, with the observation that mechanical stirring is preferable to paste manipulation. The general method used for the preparation of primary seed consists of dissolving 3000 g of sucrose in 1200 g of water, heating the solution to 235°F, adding 300 g of a full invert syrup (for reducing viscosity and inhibiting crystal growth) and raising the temperature to 240°F. The mixture is then poured into a stainless steel beaker and allowed to cool to 105°F before agitating with a heavy-duty stirrer. Stirring by hand is necessary for about 20 min before the milky liquid is fully developed ; 1800 g of partial invert or 1000 g of molasses is finally added to the mixture. Secondary seed can then be obtained by extended growth of primary seed, giving crystals of 20–80 microns for use in the pans. It is concluded that it is necessary to determine the number and size of sugar nuclei needed for the type of vacuum pans available, that controlled batch crystallization will produce the required number and size of nuclei per unit volume of seed slurry, and that the major controlling factors for successful secondary crystallization are the quality of the primary seed and the rate of cooling in the batch crystallizer.

* * *

Automatic Greasing. ANON. *Australian Sugar J.*, 1957, **49,** 455.—A system of automatic greasing of cane trucks at Mossman sugar mill has resulted in the haulage of loads 20% greater than before by the same locomotives. The opening in the truck axle boxes was welded over, to keep out dust, and a $^{5}/_{32}$in i.d. pipe inserted in the top of the boxes to act as grease nipple. The truck from the carrier is arrested at a special point, each wheel being than alongside a grease box. An electrically and pneumatically-operated arm lowers over the pipe, automatically opening a grease valve and pumping grease under pressure. A similar system has been installed at Mulgrave mill.

* * *

Bulk Handling at the Milling End. ANON. *Australian Sugar J.*, 1957, **49,** 417–423.—The bulk handling equipment installed at the seven sugar mills in the Mackay district is described with illustrations. At Pleystowe a gantry travels the length of the storehouse on a rail along the wall, another rail for support being mounted in the ceiling of the shed. This supports a gantry arm, which can be lowered or raised, pivoting about the lower end of the gantry, and which carries a one-way bucket conveyor. Sugar fed from the drier passes through an automatic weigher, then along a belt conveyor half way up the wall and is fed via a chute on the bucket conveyor, which piles it against the far wall, the pile sloping to ground level at the near wall. For reclaiming, the gantry arm is lowered on to the stack, travelling to and fro along the pile, the buckets on the underside of the gantry arm scraping on to a conveyor belt below floor level. The sugar is taken to a bucket elevator, and thence to bins feeding the rail boxes. Outgoing sugar at North Elton and at Plane Creek is scraped into a conveyor tunnel in the centre of the storehouse floor by reclaiming gantries similar to that at Pleystowe, the essential difference lying in the suspension of the gantries horizontally and not vertically as at Pleystowe. Both North Eton and Plane Creek are equipped with steel band conveyors, the former having two gantries in the storehouse, the latter only one. North Eton feeds sugar to one 50-ton bin, while Plane Creek has two. At Marian mill the sugar is weighed automatically (with an accuracy of $\pm$ 1%) on a set length of conveyor belt. The 4 sugar bins have a total capacity of 100 tons, the 4 boxes on a rail truck being filled simultaneously from 4 hoppers situated under overhead conveyors. Reclaiming is by means of a drag-line scraper, operated by winch and pulley block, with a capacity of 1 ton. Damage to the floor is avoided by laying a steel sheet over the existing wooden floor. The pulley is movable to various positions around the storehouse walls. The sugar drops through a grating into a bucket elevator taking sugar to the 4 outloading bins. One man operates the scaper, one being stationed at the bins. The only storage space at Cattle Creek is a 450-ton bin of 45° slope, the sugar being fed by belt conveyor. From the bin the sugar is fed to the first of 3 belt conveyors, thence to 4 small hoppers of 50 tons total capacity, so designed to load the 4 boxes on the rail truck without moving the truck. Three scrapers on the final conveyor can be adjusted to feed sugar into a selected bin, only 1 man being required to handle the bulk sugar. The hopper at Condong is similar to that previously described, but has an emergency side chute for pouring of the sugar on to the storehouse floor. Sugar at Farleigh is fed either to a main conveyor leading to the 350-ton bin, or is

[1] *I.S.J.*, 1956, 58, 99.

distributed over the floor of the house by a thrower, reclaiming being done by means of a tractor-mounted bucket-scoop, which takes it to a hopper situated over the main conveyor mentioned above. The bin is 250–300 feet from the factory or from the storehouse to keep the road trucks clear of tramway and railway traffic. A deflector is mounted beneath the bulk bin to ensure even loading. Racecourse mill has a 150-ton bulk bin, sugar being diverted to mobile conveyors and onto a thrower in the storehouse when the bin is full. Reclaiming is carried out as at Farleigh, with 3 men per shift.

* * *

New Type Dust Collector. ANON. *Sugar y Azúcar*, 1957, **52**, (9), 33.—Developed and manufactured by Pulverising Machines Division of Metals Disintegrating Co., the equipment comprises cylindrical filter elements carrying felt, ceramic, or metal media, and mounted vertically in a dust-proof housing into which dust-containing air is admitted through an inlet near the bottom. Clean air is withdrawn from within the cylinders, while dust adhering to the outside is removed periodically by jets of high-pressure air introduced through specially-contoured venturi mounted above each cylinder. The jets are controlled by solenoid valves actuated by an electronic timer which permits one element to be cleaned at a time, thus permitting a continuous flow of dust through the collector.

* * *

Bulk Raw Sugar Handling in Cuba. E. L. SYMES. *Sugar J.* (La.), 1957, **20**, (4), 44.—Recent developments and past achievements in Cuba are discussed. It is considered that within the near future a very high percentage of the raw sugars made in Cuba will be handled in bulk from the centrifugals to the ships.

* * *

Instrument for Remote Indication of Liquid Level. G. A. KAMINSKII. *Sakhar. Prom.*, 1957, (10), 35–37. A float is attached to one end of a chain, at the other end of which is a counterweight. The chain passes over a wheel, connected by gear (ratio 1:4) to the shaft of a Selsyn motor. Movement of the chain turns the rotor of the first motor, which sets up a compensating current, so that the needle attached to the shaft of a second Selsyn motor will register the level of water in a supply tank. The indicator scale is graduated to 330°, and the maximum angular error is 1°. Up to 3 indicating units may be connected to one transmitting unit.

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Effect of Juice Vapour Withdrawal on Evaporator Performance. M. L. VAISMAN and N. YU. TOBILEVICH. *Sakhar. Prom.*, 1957, (10), 46–49.—A method of withdrawing vapour from the calandrias of evaporators instead of from the space above the juice is discussed and shown to have no advantages, but rather to incur unnecessary expense.

Affination of Yellow Sugar with Unheated Green Syrup. YU. D. KOT. *Sakhar. Prom.*, 1957, (10), 57–60.—Factory-scale tests have shown that the quality of the affined product depends on temperature and concentration of green syrup used. A reduction in the temperature of 80°Bx green syrup causes a drop in the quality, but at 76°Bx and lower, decrease in temperature has no effect. In the case of unheated syrup, the quality considerably increases with dilution. Comparative tests have shown that affination with unheated diluted green syrup gives better results than affination with syrup heated to 90°C, in each case the sugar being washed after affination. As a result, a process was adopted at Kuban No. 2 factory whereby the green syrup was not heated as before, but was diluted to e.g. 56·7% dry solids at 44°C. Tabulated results for 19 days show the colour of the affined product to be 6·9°St (compared with 36°St of the yellow sugar).

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Oscillation of Suspended Centrifugals. L.V.EPISHEV. *Sakhar. Prom.*, 1957, (10), 60–64.—The origin of centrifugal vibrations is discussed with the aid of formulae, and oscillograms given for various types of 2nd product massecuite centrifugals under various load conditions and at different speeds. It is pointed out that oscillations may be caused both by forced vibrations due to the machine's unbalance and by vibrations from neighbouring centrifugals, the most dangerous being the horizontal external vibrations which have a frequency equal to that of the machine's natural vibrations. The oscillograms show that the experimental PN–1000 centrifugal is satisfactory both from technological and from mechanical points of view. Capable of four speeds (100, 250, 750, and 1500 r.p.m.), with automatic speed change and timing device, this centrifugal has one defect, namely the proximity of its speed during loading to the critical speed (270 r.p.m.). This fault can be eliminated by installing an absorber of softer rubber. It is emphasized that the optimum critical speed of the basket running idle must be lower than the speed when it is filled with massecuite, thus ensuring that, even when loading starts immediately after discharging and the machine momentarily runs at critical speed, the vibration amplitudes will not greatly increase and self-alignment will take place at load speed. To eliminate oscillation, it is necessary either to increase the rigidity of the bearings and improve the insulation, or to balance the resonance of the forced vibrations against the frequency of the natural vibrations by modifying the rigidity of the spring damping device.

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A Useful Method of Judging the Performance of the Low Grade Department. K. DOUWES DEKKER. *Bull. Sugar Milling Res. Inst.* (Natal), 1957, (4), 33–35.—The H.V.A. method[1] of judging molasses exhaustion is described. A sample of final molasses is diluted and warmed to dissolve any grain present,

[1] *I.S.J.*, 1942, **44**, 104.

and true purity calculated from the sucrose content and refractometric Brix adjusted for the dilution. Part of the original sample is placed in a weighing bottle after adding pure sucrose crystals, the bottle kept in a thermos flask at room temperature for 3 weeks, and the refractometric Brix is determined without separating the crystals. From the equilibrium purity obtained, the target purity corresponding to the final brix of 85° is obtained using an empirically derived monogram. The difference between the actual and target purities does not, however, give any indication of the cause of poor results. The coarse and fine sugar content can be calculated by means of the original undiluted refractometric Brix and that of the sample which has been filtered through an 80-mesh sieve to remove coarse grains and the fines then dissolved. The results of four factories are examined by this method; work in all could be improved by slow heavying-up; boiling to higher brix, reducing dilution water, and longer cooling being other remedies suggested for poor results.

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Capacity Ratings of Milling Trains. C. G. M. PERK. *Bull. Sugar Milling Res. Inst.* (Natal), 1957, (4), 35–38.—The various formulae developed for the calculation of mill capacity rating are discussed. Included are the formulae of Deerr, Camp & Leonard, Parr, Royston, Hugot, Perez Alonso, Cabrera, and the working relationship used by the Java Experiment Station, in which the crushing rate is assumed to be proportional to (roller dia.)^2 × roller length. The formula of Royston[1] converted to fibre ratios is suitable for use in Natal mills, provided all milling units in one tandem are of uniform size, but does not give accurate ratings for units of different sizes. The modified formula is:
capacity rating = $e \times d^2 \times l \times 0{\cdot}0259$ short tons fibre/hr where e = number of expressions, d = diameter, and l = roller length.

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Evaporator Vessels of Special Design. II. C. G. M. PERK. *Bull.Sugar Milling Res. Inst.* (Natal), 1957, (4), 39–42.—The Semi-Kestner apparatus (with shorter tubes than the Kestner "climbing film" evaporator previously described[2]), the Pokorny apparatus, and Claassen's compound evaporator are discussed and illustrated. Typical working figures are given by way of example.

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Continuous Filtration. G. VERNOIS. *Génie Chimique*, 1957, **78**, 66–69.—The advantages of the non-cell-divided rotary vacuum filter are discussed and the Olier filter described. From first carbonation muds limed to 2% CaO and containing about 200 g/litre solids (principally $CaCO_3$), the filter removes 135–170 kg cake (moisture content 50%) per sq. m./hr. In a factory with daily throughput of 2000 tons of beet are required: two 3·3 m diameter clarifiers for first carbonation juice, and two rotary filters, each of 20 sq. m. filter surface and each requiring 4 kW. The combined daily throughput of these is 163 tons of 50% dry solids, and 114 cu. m. of wash water is needed containing 0·4% sugar on discharge. A 34 kW water-ring pump, drawing 20 cu. m. air/min will provide average vacuum for the two filters, but can be replaced by a steam jet ejector. The use of "Orlon" filter cloths is advocated. One or two suffice for one campaign, and they are easily changed.

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Sugar Cane Mill Drives. E. BLAUENSTEIN. *Brown Boveri Rev.*, 1956, **43**, 147–152; through S.I.A., 1957, **19**, Abs. 655.—The various types of steam and electric drives for cane mills are briefly reviewed from the standpoint of efficiency. It is concluded that the ultimate type of drive for individual sections of the cane mill will be by slip-ring motors with frequency regulation, even though it will be necessary to have a second fixed frequency turboset for other plant in the factory. Direct current gives the greatest number of advantages, especially when derived from a Ward-Leonard generator connected by a gear to the turboset in the factory power plant. Other arrangements for existing installations are discussed.

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Control of the Chemical Process of Boiling-Out Evaporators. G. VARVINECZ. *Cukoripar*, 1957, **10**, 73–76; through S.I.A., 1957, **19**, Abs. 815.—The process of cleaning with Na_2CO_3 followed by HCl is controlled by taking samples during boiling-out and determining the carbonate content and alkalinity, and the total solids content by Brix. For the latter, the coefficient of expansion of salts is assumed to be the same as for water, so specific gravities are additive. Tables of Brix are given for Na_2CO_3 mixtures with oxalate, sulphate or sulphite, and for HCl + $CaCl_2$, from which the normality can be correlated with the g.p.l. Then for example, oxalate content can be found for a given carbonate content and Brix, and the percentage of Na_2CO_3 converted to oxalate can be calculated. Similar calculations can be made for other ingredients and for the acid-washing stage to indicate the amount of scale dissolved.

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Diffusion of Sugars from Sugar Cane. C. VAN DER POL and C. M. YOUNG. *Comm. Sugar Milling Res. Inst.* (Natal), 1957, (38), 19 pp + 2 appendices, and graphs.—The theory of cane diffusion is discussed and application of Fick's molecular diffusion law to leaching and dialysis considered. From the fundamental equation and from derived equations it is it is concluded that for maximum diffusion Fick's proportionality constant K, temperature, time, and concentration gradient must be at a maximum, and the viscosity and especially slice thickness at a minimum. It is pointed out that K can be used as a guide to efficiency only when the diffusibility and shape of the cane chips can be assumed constant. Laboratory experiments were carried out batchwise under conditions approaching parallel flow to test the theoretical equations and determine the values of

[1] *I.S.J.*, 1948, **50**, 12.
[2] *I.S.J.*, 1958, **60**, 140.

K for dialysis. The tests were not accurate enough to give conclusive results, but showed that K decreases with increased extraction. Pilot plant experiments were carried out with water at higher than 95°C and using a diffuser comprising a single scroll in a horizontal trough. The cane was shredded by a fixed blade hammer mill, 10% of the shredded cane being chips > ¼ in. In spite of certain faults in the design it was concluded from the results that under carefully controlled conditions diffusion combined with milling will give better extractions than milling alone.

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Thoughts on the Vacuum Pan Station. G. R. CHANDER. *Indian Sugar*, 1957, **7**, 389–392.—Calculations of pan capacity and evaporation rate, vapour pipe sizes, condenser size, injection water required, and vacuum pump capacity are given for a factory with a daily crushing capacity of 1000 tons of cane.

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The New 3-Boiling System Using "A" Molasses Granulation. D. E. BATENGA and P. H. SING. *Sugar News* (Philippines), 1957, **33**, 451–455.—The standard Puerto Rican boiling system is described. *A*-molasses of 62 apparent purity is boiled to 1·35 supersaturation; after the addition of sugar dust suspended in alcohol, boiling is continued under constant vacuum for 20 min, the supersaturation being maintained in the metastable zone. Further molasses is added as required and the boiling continued to 85°Bx. Half of the massecuite (the so-called "virgin strike") is discharged to No. 1 grain tank, while the remainder is charged with *A*-molasses and the whole boiled to 85°Bx. One half of this massecuite (the grain strike) is stored in No. 2 grain tank, and the remainder charged with a mixture of *A*- and *B*-molasses such that the resulting massecuite, which is the *C*-footing for *C*-strikes, has a purity of 58. After boiling to 85°Bx half of the massecuite is sent to No. 3 grain tank and the other half boiled with *A*- and *B*-molasses to a *C*-strike of 96°Bx and 58 apparent putiry. The cycle is repeated for the footings and grain strikes. Advantages claimed include: well shaped crystals of improved refining quality and which are easily purged; no molasses recirculation; increased pan and centrifugal capacity; increased crystal yields; freedom from conglomerates and false grains; and elimination of washings in the *A*-and *B* centrifugals. A typical solids balance is given.

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Weighing of Sugar on Continuous Belt Conveyor Type Scales. P. E. CANCIENNE. *Paper read to Amer. Soc. Sugar Cane Tech.*, 1957.—Methods of checking the continuous band weigher, on which all sugar from the centrifugals at Lula factory is weighed, are described. These included comparing the weight of sugar loaded into a truck with that registered by the band weigher, running the belt conveyor empty for ½ hr to check for any increase in the scale reading, and ensuring that brushing of the conveyor is faultless. Errors of 0·35%, 0·23% and 0·57% were recorded for 1954, 1955 and 1956.

Weighing of Sugar on Continuous Belt Conveyor Type Scales. J. T. LANDRY. *Paper read to Amer. Soc. Sugar Cane Tech.*, 1957.—The procedure adopted at Oaklawn raw sugar factory for checking the continuous band weighers is described. About 10,000 lb of sugar weighed on the belt weigher was dropped into wheeled dollies and weighed on a platform scale, giving a correction factor of about 3%. This correction factor keeps the Oaklawn weights and the platform scale weight recorded at the refinery to which the raw sugar is sent to within 1%. Inefficient brushing of the belt is blamed for the error, and the author recommends that the scales be checked against dead weight scales at least once a week to obtain the necessary correction factor.

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Fresher Cane Increases Sugar Recoveries and Profits for both Growers and Processors. W. F. Guilbeau, E. E. COLL, and L. F. MARTIN. *Paper read to Amer. Soc. Sugar Cane Tech.*, 1957.—The sugar recovery from Louisiana cane is discussed. A check in the fall of recovery percentages is attributed to the delivery to the mills of fresher cane, although increased production of the superior CP 44–101 has contributed to the improvement. Experiments during 1954 and 1955 showed that improvements could be expected if the average delay in grinding were reduced to less than 48 hr. It is claimed that CP 48–103 should produce 200 lb of 96 pol raw sugar per ton if ground as soon as possible after harvesting. Estimates of losses for increasing periods of delay in grinding are tabulated, besides the monetary values per 1000 tons of cane for 1954 and 1955, and cash losses to farmers and factories.

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Weighing of Sugar on Continuous Belt Conveyor Type Scale. I. E. LEGENDRE. *Paper read to Amer. Soc. Sugar Cane Tech.*, 1957.—The bulk handling installation at Leighton factory of Lafourche Sugar Company is described. Raw sugar is elevated onto a 14 in ribbon conveyor which distributes the sugar the whole length of a steel hopper bin with a capacity of 600,000 lb through hand-operated rack-and-pinion slide valves. Sugar is discharged onto a ribbon conveyor equipped with a Fairbanks-Morse continuous weigher of 75 tons/hr capacity. From this the sugar goes to another belt conveyor inclined at an angle of 22° which delivers to a reversible shuttle belt running down the centre of the 30 million lb capacity warehouse, where it is stacked by means of a belt slinger placed beneath the discharge end of the shuttle conveyor. A petrol engine mobile shovel dumps the sugar on a reclaiming screw conveyor which takes it to the shipping bin for transporting by road or rail. The scale is checked at the start of the grinding season when about 10,000 lb of sugar have been stored, and thereafter before each storage. The scale is operated continously at maximum capacity to avoid errors. The difference between sugar stored and sugar withdrawn from the warehouse 1953 to 1956 inclusive is given as 0·47% on more than 61 million lb of sugar, part of this difference being caused by losses in shipment and residual sugar on the warehouse floor.

BEET FACTORY NOTES

The Storage of Sugar Beet. S. VAJNA. *Zeitsch. Zuckerind.*, 1957, **82**, 377–382.—The chemical and physical processes involved in respiration of the beet are described. The behaviour of withered and frozen beet is also discussed, and formulae developed for the determination of aeration, storage temperature, and sugar losses. In considering the optimum height of beet piles, it is pointed out that a large number of small piles is unsatisfactory in view of the extent of surface exposure to the atmosphere, although piles should not be too high, as with increased height the storage temperature increases considerably. Air channels are necessary for piles 3–5 m high, and for piles higher than 5 m it is necessary to have forced air circulation. The storage temperature should be 1–3°C above the average ambient temperature. Temperature curves are given for piles 1 and 1·5 m high, 20 m wide, and for those 4 m high with natural ventilation.

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The Chemical and Physical Behaviour of Non-Sugars in Molasses Formation and Refining. E. MOEBES. *Zeitsch. Zuckerind.*, 1957, **82**, 382-386.—Factory molasses was passed through an ammonium-cycle ion exchanger and the NH_4 ions then replaced with various other cations. Graphs of apparent purity *vs.* solubility expressed as sucrose/water content are drawn for the treated molasses. In one type of curve the sucrose solubility increases considerably as the purity falls (NH_4, K, and Na cations) ; and in the other, sucrose solubility falls sharply under the same conditions (Mg and Ca ions). Exchange of the molasses cations with Mg caused the sucrose solubility to fall by half. Molasses viscosity increases on replacement with Ca and Mg ions but decreases with Na and K ions. In pilot-plant trials, filtered second carbonatation juice cations were exchanged for ammonium ions and excess lime added. The ammonia was boiled off, and the excess lime removed by gassing with CO_2. After filtration the thin juice was boiled as normally. It was found that the increased lime salts content has no perceptible influence on rate of evaporator scaling ; that boiling of the juices and crystallization were normal ; grain formation during boiling of the after-products was very rapid despite a purity of 70 and the boiling time was normal, a purity of 55 being attained after 13-15 hr boiling. There was increased danger of false grain formation in the crystallizers at a purity of approximately 50. The ammonium ion exchanger remained stable, though the capacity was only 280 milliequiv./litre, which required juice dilution by about 17%. During the trials there was a loss of 0·97% sugar on beet as molasses of 84°Bx and 48·2 purity. Use of mineral acids for regeneration is not satisfactory, and a 5·5% $(NH_4)_2SO_4$ solution, using 140–150% of the theoretical requirement, was adopted for later work. An ion exchange plant at Leopoldsdorf factory, operated in 1956, included three filters each containing 8 cu. m. of "Lewatit S 100" (a polystryrene resin of 1600 milliequiv./litre capacity). Two were charged every 8 hours with thin juice and 60% of the juice was treated and mixed with the untreated 40%. About 100% excess of lime (0·22%) was added to the thin juice, and it was then carbonatated at 90–95°C, and filtered through 4 Schumacher ceramic candles. The relatively high concentration of NH_3 caused a NH_3 compression in the evaporator with a consequent drop in performance. The scale deposited was wholy calcium oxalate, neither calcium carbonate nor gypsum being found. All strikes were boiled at pH 8–8·5. In order to avoid too high a crystal content in after-product massecuites it was necessary to reduce the middle product purity. Boiling two middle and two after-products and a fall in the thick juice purity led to a molasses purity of 52–55. Crystallizer work was normal if the maximum purity of the starting massecuite was 73; otherwise cooling had to be cut short to prevent conglomeration. The use of high speed centrifugals eased the working of the after-product massecuites. Despite molasses purity of 53–55, the after-product sugar was of 92–94 purity.

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Diffusion Battery Operation by the Method of Kuban No. 2 Factory. N. F. DOBRONRAVOV and A. M. GERASIMOVA *Sakhar. Prom.*, 1957, (10), 22–24.—The process used at Kuban No. 2 factory has been officially recommended. During the 1954/55 campaign at this factory the length of cossettes worked was 28–30 m/100 g, the diffusion temperature 78°C, losses 0·37% by weight of beet, and draught 130%. Laboratory-scale tests have shown that despite reduced sugar losses in pulp (0·08%), the quality of the diffusion juice is worse due to an increased extraction of non-sugars. It is further pointed out that the increased sugar extracted may be lost in final molasses as a result of the increased molasses yield. To reduce sugar losses it is not necessary to diffuse at 78°C, but the quality of the cossettes should be improved, draught regulated, and diffusion carried out at 71–72°C (67–68°C for stored beet).

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Certain Defects in the Mandryko Diffuser. E. G. YAREMENKO. *Sakhar. Prom.*, 1957, (10), 25–31.—Some faults in the diffuser are noted. The filter screens were of insufficient area (1·4 sq.m.) and had to be enlarged to 6 sq.m. each by replacing the strip iron grids with pressed sheet iron grids 4 mm thick. Consequently the daily throughput was increased from 900 to 1300 metric tons, and sugar losses and draught were reduced. Other defects included damaged external bands and bolts, and faults in the driving gear. Details of construction and correct method of fixing bands are given.

BMA Extraction Tower at Heilbronn Sugar Factory. R. LOSERTH. *Zucker*, 1957, **10**, 433–438, 448–456, 517–520.—The diffusion plant at Heilbronn is illustrated and described in detail and the 1956 campaign results are discussed. Cossettes are pre-scalded to 69–81°C with heated diffusion juice. The diffusion chamber of the 4·5 m dia. double-scroll BMA tower diffuser has an effective height of 15·7 m and a guaranteed capacity of 1800 tons (up to 2100–2200 tons under very favourable conditions). Retention time in the diffuser is 60–70 min at a screw speed of 0·6 r.p.m. Results of diffusing 1929 tons of beet in 24 hr show loss of 0·20% on beet at a draft of 121·8, while losses on treating 2184 tons/24 hr were 0·24% at a draft of 116·0. The average pH in the tower was 5·9 and bacterial counts at 30°, 55° and 68°C show that the diffuser worked under sterile conditions. Cossette length varied from 10·8 to 15 m/100 g. The diffusion juice was bright green due to the rapid destruction of tyrosinase on reaching 72°C (the temperature of the exhausted juice was 64–79°C) and to the small amount of enzymatic oxidation resulting from the almost complete absence of atmospheric oxygen. The diffusion juice from the tower contains more pulp than juice from battery diffusers.

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A Contribution to the Theory of First Carbonatation. J. BURIÁNEK and F. DURDÍK. *Listy Cukr.*, 1957, **73**, 225–226.—A Warburg apparatus was used to determine the concentration of bound CO_2 in 1st carbonatation juice which was filtered immediately after sampling. The concentration of CO_2 attains two maxima during 1st carbonatation, the first maximum being greater. The co-existence of CO_2 and $Ca(OH)_2$ in the solution indicates the presence of complex compounds, which are unstable but may be detected after 2nd carbonatation.

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Potentiometric Method of Studying Lime Carbonatation with CO_2 in a Sugar Solution. R. KOHN and J. VASÁTKO. *Listy Cukr.*, 1957, **73**, 233–238.—The changes in pH which occur when CO_2 (or oxalic acid) is introduced into sugar solutions containing milk-of-lime were followed by studying the changes in potential of an antimony electrode. The investigations were made at 20 and 85°C and the amounts of CO_2 measured volumetrically. Indications were given by the form of the curves of the occurrence of a $CaCO_3$-saccharate complex, of the formation of a basic precipitate, and of its decomposition during carbonatation. The lowering of the potential of the saturation curve in comparison with the potential of the standard curve, determined by titrating the lime-sugar solution with HCl, when there was no precipitate, gives the % $Ca(OH)_2$ present in the basic precipitate at any given moment. The form of these curves depends on the acid used, temperature and duration of the saturation. The stability and nature of the complexes, the latter changing continuously during titration, are discussed.

Automation of Technological Processes. R. SZAREJKO. *Gaz. Cukr.*, 1957, **59**, 257–260.—The extent of automation in German and French sugar factories is reviewed and illustrated by flowsheets, and the possibilities of such automation in Poland are discussed.

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Optimal Start and Length of Campaign. S. SZYBALSKI. *Gaz. Cukr.*, 1957, **59**, 262–264.—The optimal length of campaign and when to start it are discussed in the light of past Polish experience. The question of losses in sugar content of the beets and climatic changes are considered and a period from the start of October to the end of November (10th December at the latest) suggested as an optimal period.

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Effect of Thermoplasmolysis and Selective Electroplasmolysis on the Structure of the Plasmatic Membrane of the Cell and on the Permeability of Beet Tissue. A. YA. ZAGORUL'KO. *Sakhar. Prom.*, 1957, (11), 67–71.—Studies were made of the effects of thermoplasmolysis at 50–80°C, during which the semipermeable plasmatic membrane becomes permeable to solutes while the cell walls remain intact. One method of guaranteeing the rupture of the membrane and of greatly increasing the diffusion coefficient while the cell walls remain intact is that of selective electroplasmolysis, in the course of which the cell protoplasm is denatured when subjected to a potential gradient of 1800–2000 V/cm and to selective heating, and becomes detached from the cell. A potential gradient of 2500–3000 V/cm causes the denatured plasmatic membrane to disintegrate and results in a considerably higher diffusion coefficient of sugar. This is therefore considered a good basis for highly efficient diffusion.

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Use of the "Immedium" Filter in the Werquin Process. B. BERNADAC. *Ind. Alim. Agric.*, 1957, **74**, 629–636.—Semi-industrial and industrial trials have been made on the use of the "Immedium" sand-filter[1] for separation of the initial precipitate produced by liming raw juice to the "Werquin" point (4·2 g CaO/litre), and heating to 85°C. The trials indicate that the filtration cycle will be of at least as great duration as with filter-presses. Sweetening-off is almost equivalent to that with presses, so far as time, water requirement and residual sugar are concerned, and satisfactory juice purification was obtained with only single-stage carbonatation after filtration.

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Sugar Beet Re-Loading Equipment in 1956. K. PEISKER. *Zucker*, 1957, **10**, 492–499.—The equipment installed in 1956 on the German Federal Railways for reloading of beet from farm vehicles into railway wagons is surveyed.[2]

[1] *See also I.S.J.*, 1957, **59**, 21.
[2] *See also I.S.J.*, 1957, **59**, 252.

New Books and Bulletins

Investigations into Bionomics, Economic Importance and Possibilities of Control of the Sugarcane Stalkborers in Java. J. RUINARD. 222 pp; 6½×10 in. (Ahrend-Globe, Hilversum, Holland). 1958. (*In Dutch with English summary.*)

Many will welcome this detailed work or thesis on the cane borers of Java, some of which are also troublesome in other countries such as India, Mauritius, the Philippines and Taiwan. While the cane borers of the New World, notably those of cane growing areas of the Caribbean region, have been studied in some detail by BOX and others, BOX's research dating from the 1920's, much less sustained scientific work or study appears to have been directed towards the sugar cane borers of Asia and Africa. The present investigations were carried out on the Sumberhardjo estate in Java during the years 1953–57, as a result of the greatly increased damage to sugar cane caused by borers in the years following the second world war.

The four species of stalkborer causing damage to sugar cane in Java and forming the basis of this study are—the purple borer (*Sesamia inferens* Walk.), the grey borer (*Argyroploce schistaceana* Sn.), the striped borer (*Proceras sacchariphagus* Bojor) and the shining borer (*Chilotraea auricilia* Dudg.). According to the author two stalkborers which formerly infested sugar cane in Java seem now to have disappeared, which may appear remarkable (these being *Chilotraea infuscatella* Sn. and *Phragmatoecia parvipuncta* Hamps.). Apart from the introduction with historical matter the thesis is divided into five sections or chapters viz.: I. Biology of the Borers, II. Methods for Determining Extent of Infestation, III. Extent and Development of the Infestation, IV. Yield Losses caused by Stalkborers and V. Control of the Stalkborers. A lengthy and useful bibliography follows. There are no illustrations.

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Manual Azucarero Mexicano 1958. ED. J. G. CARDENAS. 308 pp; 7¾×10 in. (Cia. Editora del Manual Azucarero S.A., Balderas No. 44, Desp. 112–113, Mexico 1, D.F.). 1958. Price: $Mex. 75.00 ($U.S. 6.00).

This is the first edition of a book destined to become a valued member of the useful group of yearbooks issued in various sugar-producing countries. It is in Spanish and is devoted entirely to the Mexican sugar industry, which it reviews generally in a short article. A colourful map illustrates the location of each of Mexico's 71 factories which are listed with their operating Companies. Details of individual factory production are given in a table, followed by the section which occupies most of the book, the individual factory descriptions. These give executive and administrative personnel, offices and communications, as well as information on cane handling, milling plant, steam raising equipment, electrical plant, clarifiers, evaporators and pans, condensers, crystallizers, centrifugals, and storage of sugar and molasses, etc. Details of refineries and distilleries are given with the factory data, which also include miscellaneous information on the previous five years' results, detailed results from the 1957 season, and certain agricultural data. There follows a section giving objects, addresses and personnel of Mexican sugar organizations; a set of calculation and conversion tables, a directory of factory personnel, a Buyers' Guide, and the index to the advertisers.

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Memoria de la XXX Conferencia Anual de la Asociación de Técnicos Azucareros de Cuba. 568 pp; 6½×10¼ in. (Asociación de Técnicos Azucareros de Cuba, La Habana, Cuba). 1956. Price: $10.000.

As in previous *Memoria*, lists are given of the founder-members of the Association, ex-Presidents, Consultative Council, patron members, and officers of the Association for 1956 and 1957. Obituaries and "Table of Honour" follow, with persons attending the 30th Conference. The index then gives a list of the 53 papers read at the Conference, followed by their text, and finally a series of appendices concerning "Sugar Cane Day" (4th November 1956), the first Sugar Industry Exhibition in Cuba, discussions on the Conference, instructions to intending contributors to the Conference; activities of the Cuban subcommittee on uniformity in analytical methods; information given by delegates to the 9th I.S.S.C.T. Congress, and Cuban crop statistics from the 1956 season.

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The Gilmore Manual Azucarero de Cuba—Cuba Sugar Manual, 1958. ED. F. I. MEYERS. 470 pp; 8×10½ in. (The Gilmore Publishing Co. Inc., 525 Audubon Building, New Orleans 16, La., U.S.A.). 1958. Price: $10.00.

The latest edition of the Gilmore Cuba manual follows the same pattern as the previous editions[1], with the sections giving detailed and useful information on both the Cuban industry and organizations and on the individual factories. The equipment (except for a very few factories) is that installed for the 1958 season, while comparative factory results are listed for the 1956 and 1957 crops. Gilmore provides an up-to-date and complete source of reference to the Cuban industry which will be invaluable to anyone concerned with that country.

[1] *I.S.J.*, 1957, **59**, 161.

Laboratory Methods and Chemical Reports

Determination of the Total Fermentable Sugars in Final Molasses. V. A. DANIL'TSEV and YA. O. MATEUSH. *Sakhar. Prom.*, 1957, (10), 31–32.—The empirical formula given officially for calculating total fermentable sugars from pol data is:

$$E_f = S_1 + 0{\cdot}95 \text{ invert} + 0{\cdot}34\,R$$

where E_f = total fermentable sugars, S_1 = sucrose content, and R = raffinose content. S_1 is determined by $\frac{0{\cdot}5124\,P + I}{0{\cdot}8474}$, where P = direct pol, and I = pol after inversion. The theoretical amounts calculated using this formula are shown to be lower than the actual amounts determined by chemical analysis, and revision of the official instruction for receipt of final molasses at distilleries is therefore recommended.

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Ferricyanic Saccharimetry and Mercurimetry. Their Applications in Chemical Analyses. A. IONESCO-MATIU. *Produits Pharmaceutiques*, 1957, **12**, 247-254; through *S.I.A.*, 1957, **19**, Abs. 693.—Details are given of the method of determining reducing sugars by titrating a boiling alkaline solution of potassium ferricyanide with the reducing sugar solution; the end point can be determined directly, using picric acid as indicator turning from yellow to red (picramic acid); alternatively, for low reducing sugar contents, an indirect method can be applied, in which the ferricyanide and sugar are boiled together for exactly one minute, the solution is then cooled, diluted and acidified with H_2SO_4, and the solution (ferrocyanide) is titrated with $KMnO_4$ until the green colour is replaced by pink. Various applications of the method are given. The mercurimetric method also described consists of mixing the sugar solution with NaOH solution and the mercury reagent (HgI_2 + NaI solution), boiling for 3 minutes, cooling, centrifuging and washing the mercury precipitate, and dissolving it is H_2SO_4–HNO_3 mixture; the mercury is then determined by adding sodium nitro-prusside to give a cloudiness which disappears on titration with NaCl solution; alternatively, excess NaCl may be added, and the mixture is back-titrated with $HgSO_4$ solution. A volumetric-colorimetric method is also briefly described: the sugar solution is heated, in a boiling water-bath, with $HgCl_2$ and NaOH solutions for 1½ min; after cooling, a few drops of $Mg(OH)_2$ suspension is added and the mercury precipitate is centrifuged and washed; on addition of Folin's phosphotungstic reagent and heating, an intense blue colour is formed; on dropwise titration with cerium sulphate, the solution is decolorized with a clear end-point. The method can be applied to amounts as low as 10γ of reducing sugar.

A Simple Paper Chromatographic Method for Separation of Sugars. J. HENZE. *Naturwiss.*, 1957, **44**, 442–443; through *S.I.A.*, 1957, **19**, Abs. 694.—A circular filter paper (21 cm dia.) is held between two thin-walled hemispherical glass vessels. A wick in the centre of the paper dips into solvent in the lower vessel. The difference in saturation of the air by the solvent in the upper and lower vessels aids evaporation in the upper vessel, and hence aids the steady flow of solvent up the wick and across the paper. A 45:5:50 butanol-ethanol-water solvent mixture is preferred. Good separations of various sugars have been obtained especially of glucose from galactose and xylose from lyxose. Arabinose, mannose and fructose could not be separated with this solvent mixture, but they were readily distinguishable by suitable spraying reagents, e.g. phloroglucinol or aniline phthalate. The method was also suitable for amino-acids.

* * *

Effect of Dextran on the Filtration of Sugar Juices. K. VUKOV. *Elelmezési Ipar.*, 1957, **11**, 91–94; through *S.I.A.*, 1957, **19**, Abs. 785.—Filtration experiments were carried out with model solutions and the filtrability at 100°C was measured with Silin's apparatus. Solutions of 10 or 15% of sugar with 5% of $CaCO_3$ and 0·01 to 0·08% of dextran were tested. The effects of the dextran were much worse than those of pectin. The decrease in filtrability on adding dextran is not due to its viscosity but to its adsorption on the precipitate and filter cloth; the effect is connected with the molecular weight of the dextran. The mol. wt. is reduced by treatment with sodium hypochlorite; the effect can be used to indicate the presence of dextran and to improve the filtrability of factory juices.

* * *

New Theory of the Formation of the Cane Sugar Crystal. S. B. DATTA. *Indian Sugar*, 1957, **7**, 327–331.—Theories and investigations of sucrose crystals formation are discussed. The author postulates that the sugar crystal is not a true crystal but a conglomerate of micro-crystals embedded in a matrix of unoriented amorphous sugar. The micro-crystals, being oriented in a definite pattern, give rise to a definite pattern in the structure of the macro-crystal.

* * *

Relationships between Surface Area and Fineness of Slightly Soluble Phosphates. W. L. HILL. *Proc. 4th Tech. Session Bone Char*, 1955, 247–266.—Measurement of the size of non-porous fine grains which constitute a granule of such material as phosphate rock and steamed bone is shown to indicate the magnitude of the primitive grain surface, of which the

outer surface is completely accessible to the reagent used for surface measurement, while the inner surface is only partly accessible. However, these two surfaces can be made sensibly equal by a sufficient reduction in the size of the granule, so that a plot of the ratios of the two measurements for a wide range of granule sizes will show a plateau giving the fineness range in which the ratio is independent of the granule size. Radio-phosphorus exchange and nitrogen adsorption were used to measure the surfaces of steamed bone, which gave a fineness of <200 mesh, the value of the plateau ratio (which is also the calibration constant for the exchange) being 62 grams P/sq. m. Measured and geometric surfaces of other materials are also compared. Phosphate rock is not sufficiently homogeneous to compare surface measurements by different methods.

* * *

Laboratory Column Tests for Evaluating Granular Adsorbents. N. L. PENNINGTON. *Proc. 4th Tech. Session Bone Char*, 1955, 299–323.—A description is given of a laboratory apparatus containing a bone char column of 2·5 in i.d., 6·5 in high and with a capacity of approximately 500 ml. Tests are described, using a flow rate of 300 ml/hr, a temperature of 80°C (176°F), and a phosphate-defecated Hawaiian raw sugar liquor of 66·5°Bx. Reproducibility of the tests was good and results show that such tests are better for qualitative prediction of the performance of a char than the batch tests. The apparatus is illustrated and results are tabulated showing the relationship between the test results and colour removal data in the factory.

* * *

Determination of Total Cations in Commercial Sugars. L. P. DOMINGUES. *Proc. 4th Tech. Session Bone Char*, 1955, 347–355.—An ion-exchange method of determining the total soluble cations in a commercial sugar liquor is described. A known weight of sugar was dissolved to make 100 ml of 60°Bx liquor and some of this diluted and passed through a cation-exchanger. The sugar in the column was displaced with distilled water and a potentiometric titration made on an aliquot of the total effluent to endpoint pH 8. The results of a number of determinations give a linear correlation with ignition ash expressed as ash % = 5·95 × m. equiv. acid liberated — 0·01. Advantages of the method include the short time required for results (obtainable within 1 hr), while one disadvantage is the inability to detect such constituents as silica.

* * *

Experiments on the Removal of Ash Constituents with Bone Char. A. GEE. *Proc. 4th Tech. Session Bone Char*, 1955, 357–371.—Tests on the removal of soluble ash from sugar liquors with a laboratory column are described. The dependence of the amount removed on the liquor composition and on char pre-treatment was primarily investigated. Other aspects covered were the sweetening-off process, the washing of char with water and carbonate solutions, and the estimation of the gradient of the adsorbed ash within the column, which is nowhere sharp. ^{45}Ca was used in experiments on adsorption and desorption of Ca ions by bone char. It is concluded that the char can absorb ions selectively and that the Ca of the char exchanges appreciably with Ca in the solution phase. Bivalent cations are more appreciably adsorbed than univalent ions, but it cannot be said from the results whether ash removal by bone char is primarily a case of molecular adsorption or of ion exchange.

* * *

Thermal Stability of Adsorbent-Treated Liquors. H. P. FREEMAN and A. J. WEISS. *Proc. 4th Tech. Session Bone Char*, 1955, 373–385.—The stability of various sugar liquors kept up to 13½ days at 70, 80, and 100°C was estimated by measuring the pH and the transmittance of each sample in visible and ultraviolet light over the range 200–720 mμ. In the early stages of storage (up to 3½ days at 70°C) the invert sugar, invert sugar-degradation products, and colour increased significantly at refining temperatures, although the differences between the increases in the liquors treated with bone char, activated carbon and with ion-exchange resins became less apparent with prolonged storage and at higher temperatures. Ultraviolet absorption provides a good indication of the presence of sucrose degradation products, one of which may be 5-hydroxymethyl-2-furaldehyde. The temperature coefficient of a characteristic absorption maximum at 284 mμ was very large. A decrease in pH was observed in each experiment and always accompanied by invert sugar formation. The rapid drop in pH that occurs initially in the refining process could lead to a great loss in sucrose if there were inadequate pH control.

* * *

The Microbiology of Beet Sugar Manufacture. A. JANKE and R. G. JANKE. *Zeitsch. Zuckerind.*, 1957, **82**, 485–490.—The various types of bacterial infection and the organisms responsible are reviewed. Methods of measuring bacterial count and determining microbial activity are discussed and the advantages of using tetrazolium salts considered. These are colourless, but are reduced to highly coloured formazans by reaction with cells capable of multiplication. Both aerobic and anaerobic microbes may be detected. The salts may be used in alkaline medium, thus permitting detection of microbes during pre-defecation; the reaction is irreversible, so that the colour does not disappear, and the coloured microbes can be separated by suitable filters. One disadvantage of the indicators is their toxicity. Methods of combating bacterial infection are also reviewed.

* * *

The Use of Sugars in the Respiration of Yeast Suspensions. K. DAMASCHKE and R. LORENZ. *Zeitsch. Zuckerind.*, 1957, **82**, 490–495.—The influence of various sugars on the respiration of yeast suspensions is investigated and results shown graphically. Monosaccharides caused a rapid change in the rate, whereas equal additions of di- and trisaccharides did not cause any increase in the rate for 4 to 10 min due, it is suggested, to the difference in their rate of fermentative decomposition to monosaccharides.

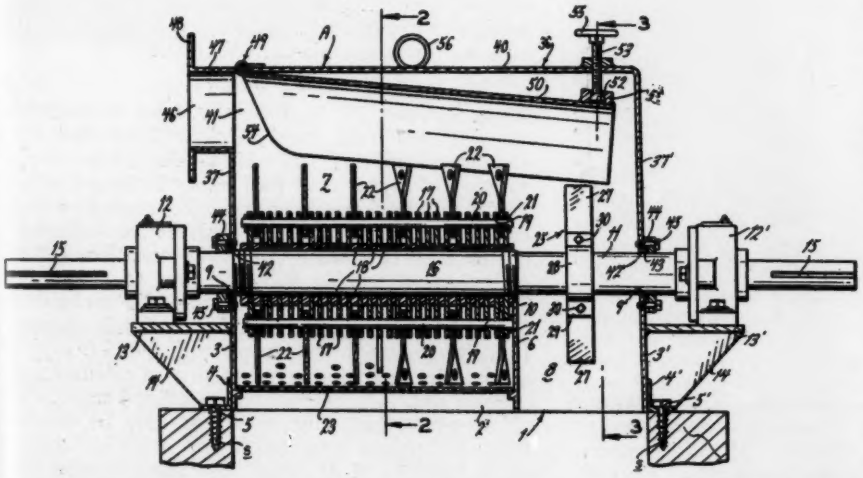
PATENTS

UNITED STATES

Use of Magnesium Carbonate Trihydrate in a Preliming Carbonatation Process. A. M. ZENZES, of New York, N.Y., U.S.A. **2,824,028.** 26th January 1954; 18th February 1958.—Cane juice or preferably beet juice at a temperature not higher than 60°C is limed with up to 0·6% CaO to give a pH of 10–11 (10·8). Sufficient reactive magnesium carbonate trihydrate is then added to give a pH of 9·6–10·0 and the mixture agitated until substantial decolorization has taken place, when the precipitate is removed. The limed juice may be heated to 85°C before adding the $MgCO_3,3H_2O$ and/or it may be limed after agitation to a pH of 10–10·4 (10·2) to precipitate the dissolved magnesium. After removal of the precipitate the juice may be carbonatated to pH 8·8.

* * *

Defiberizing Bagasse. L. FREEMAN, assr. GRUENDLER CRUSHER & PULVERIZER CO., of St. Louis, Mo., U.S.A. **2,825,935.** 25th February 1953; 11th March 1958.—The apparatus is basically the same as described in an earlier patent[1] but a hinge 49 is provided in the upper portion of the endwall where the bagasse enters. From the hinge is supported a substantially hemi-cylindrical plate which is cut away at the corners 54 to permit up and down movement about

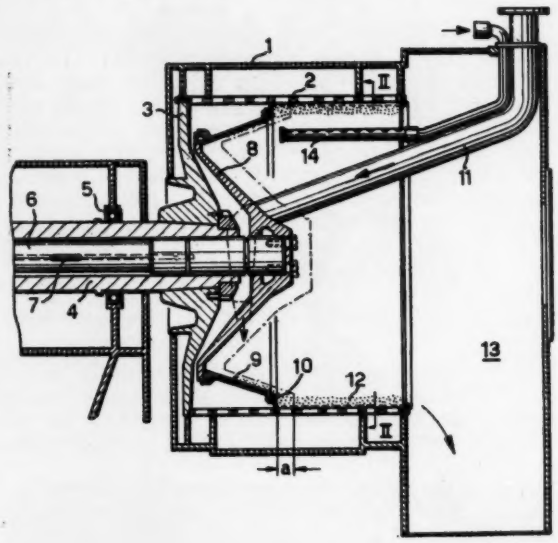


the hinge as a result of the action of adjusting screw 53 which is linked to the plate by a ball and socket joint 52. The plate maintains the back pressure of the bagasse against the hammers and compensates for the loss of volume by separation of the pith.

* * *

Beet Topper. H. C. OPPEL, of Boise, Idaho, U.S.A. **2,826,890.** 7th September 1954; 18th March 1958.

Push-Type Centrifugal. E. RUEGG, assr. ESCHER WYSS A.G., of Zurich, Switzerland. **2,828,021.** 27th May, 1957; 25th March 1958.—The solid shaft 6 is connected to hollow shaft 4 by means of a key 7 so that they rotate together but shaft 6 is able to move



axially relative to shaft 4. Shaft 4 carries a boss 3 to which is attached the centrifugal drum 2. Shaft 6 carries a conical disc 8 from which extends a frustroconical feed drum 9 with a solid smooth inner face. At the rim of the drum 9 is an annular pusher ring 10. Material to be centrifuged is admitted through pipe 11 which delivers on to drum 9. The shape of the drum causes it to be deposited as a layer 12 on the drum 10 and it is pushes along by reciprocating movement of the pusher ring 10 and so carried eventually to the collecting chamber 13. Wash liquid may be applied through the perforated pipe 14.

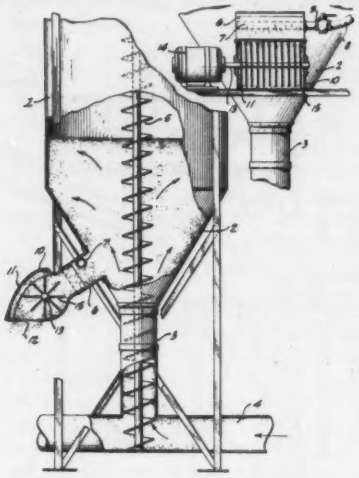
* * *

Safety Device for Centrifugal Machines. R. J. HUSER and C. J. SCHULTZE, assrs. THE WESTERN STATES MACHINE CO., of Hamilton, Ohio, U.S.A. **2,828,020.** 9th April 1954; 25th March 1958 (see U.K.P. 768,766)[2]

[1] U.S.P. 2,760,234; *I.S.J.*, 1957, **59**, 166.
[2] *I.S.J.*, 1957, **59**, 323.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 2s each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

Molasses Mixer for Dry Cattle Feed. B. W. VANDENBERG and A. VANDENBERG. **2,829,871.** 18th August 1955; 8th April 1958.—Dry cattle feed is brought along pipe 4 and elevated into tank 1 through pipe 3 by



means of the driven worm conveyor 5. It leaves by way of outlet 6 which is situated below a perforated pipe 7, supplied with molasses through line 8. Molasses entering the dry feed stream is mixed with it by rotating arms 15 driven by motor 14.

* * *

(Beet Diffusion) Tower. K. HEINRICH, of Grevenbroich, Germany. **2,828,230.** 4th March 1953; 25th March 1958.—The patent covers the tower part of the diffusion equipment covered by U.K. Patents 782,651 and 781,652[1] but also includes a pressure sensitive device comprising a flexible membrane in the top of the cossette distributor which measures the difference in pressure between the column of cossettes and the pressure exerted by the cossette pump, and converts this difference into an electrical impulse which is used to control the operation of the pump.

* * *

Production of Monosodium Glutamate. R. W. SHAFOR and E. K. HEEGAARD, assrs. INTERNATIONAL MINERALS AND CHEMICAL CORP. **2,829,161.** 15th November 1955; 1st April 1958.—Concentrated Steffen's filtrate is treated to remove virtually all its calcium content by treatment with either sodium carbonate or an alkali metal phosphate at a pH higher than 8·5 to precipitate calcium carbonate or phosphate. Glutamic acid precursors are hydrolysed with caustic soda and the hydrolysate mixed with "crude glutamic acid re-pulp liquor" from a later stage in the process. The mixture is concentrated to precipitate inorganic salts; these are removed and the glutamic acid precipitated at about its iso-electric point. The crude crystals are mixed with "purified glutamic acid mother liquor" obtained from a later stage in the process, and then separated, the filtrate being recycled as "crude glutamic acid re-pulp liquor". The crude glutamic acid crystals are dissolved in caustic soda to a pH of 5–8, decolorised with carbon, and precipitated at the iso-electric point. The mother liquor is recycled as "purified glutamic acid mother liquor" while the purified crystals are dissolved in caustic soda to a pH of 5–8 and concentrated to crystallize the monosodium glutamate. These crystals are separated and the mother liquor returned to the decolorised solution.

* * *

Recovering Sugar from Natural Products containing it. G. HINGST and W. EMTE, assrs. FRIEDRICH UDE G.M.B.H., of Dortmund, Germany. **2,829,985.** 27th September 1955; 8th April 1958.—Sugar is recovered from substantially dry sugar-containing substances by extracting with liquid ammonia and mixing with a solvent (methanol) which may be a mono- or di-hydric alcohol, ketone, formamide, methyl formamide, dimethylformamide or a mixture of these or at least one of them mixed with an aromatic hydrocarbon. The proportions of the precipitant-free ammonia-solvent mixture are adjusted so as to precipitate the high molecular weight impurities which are separated. The proportions are then adjusted to give a solution of ammonia in solvent (less than 8%) either by removal of ammonia or by addition of more solvent, so as to precipitate the sugar as a sugar-ammonia compound from which the ammonia is removed by heating. Up to 2% by weight of e.g. CO_2, SO_2, formamide or a mixture of these may be added to the precipitant-free ammonia-solvent mixture.

* * *

Sugar Refining. E. N. EHRHART, assr. SUCRO-BLANC INC., of New York, N.Y., U.S.A. **2,829,986.** 10th December 1953; 8th April 1958.—An impure sucrose solution of higher than 98·5 purity is treated at 120–150°F with 0·06–0·30% on solids in solution of active carbon, thereafter treating with active chlorine in the form of calcium hypochlorite and then 0·035%, on solids, of soluble P_2O_5 and lime to give a floc. The temperature is raised to 180–200°F to raise the floc and carbon particles, and the solution is separated. It is decolorised by treatment with 0·035–0·15%, on solids, of active chlorine in the form of calcium hypochlorite and then crystallized as refined sugar. The chlorine-phosphate-lime treatment may be omitted, when the carbon treatment temperature is raised to about 185°F, and in either case the treatment with calcium hypochlorite may be carried out in more than one stage, allowing 10–15 min to elapse between each.

Sugar Refinery for Jordan.[2]—The Government has recently licenced the construction of the first sugar refinery which will operate on imported cane raws as neither beet nor cane can be grown successfully. The sugar imported during 1957 was about 20,000 tons. The refinery is to cost 466 million dinars.

[1] *I.S.J.*, 1958, **60**, 83.
[2] *Zeitsch. Zuckerind.*, 1958, **83**, 251.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

The Fordson Dexta. Tractor Division, Ford Motor Company, Dagenham, Essex.

The new Dexta tractor is a 32–h.p. unit designed as a "workmate" for the larger Fordson Major and is intended for use in the smaller farm and plantation. It is powered by a three-cylinder water-cooled diesel

engine, and has a 6–speed constant-mesh gearbox. It has a rear power take-off, a three-position belt pulley and a hydraulic power lift. A single quadrant controls implement position or selective depth, making continuous and automatic adjustments as required to maintain a constant working depth. A push-button-operated selector control enables auxiliary equipment to be isolated from the main services.

* * *

Interchangeable Standard Rotameters. Rotameter Manufacturing Co. Ltd., Croydon, Surrey.

Improvements in manufacturing technique have made it possible to produce a metric series of Rotameters of which the essential elements (metering tubes and floats) are made to such a degree of interchangeability that, for many industrial applications, individual calibration is no longer necessary. The flow scale is engraved not on the measuring tube but on a separate plate which permits the conversion of an instrument for use on another fluid by the simple replacement of the scale plate. Floats are available in stainless steel, light alloy and a ceramic material, for various applications, and the tubes are of eight sizes, accommodated in one of five sizes of frame. Features of the new standardised equipment are the expanded and externally ground ends of the metering tubes for accurate fitting in their glands; interchangeable gland packings of synthetic rubber or P.T.F.E.; a welded steel chassis thickly coated with black nylon for corrosion protection; standard connexions with flanges in accordance with the appropriate British Standards, made of cast-iron, stainless steel or rigid P.V.C.; enclosure in four panels of transparent "Perspex" ("Plexiglass"). The chassis may be suitable for standard or panel mounting and in the latter case, flame-proof strip lighting can be included.

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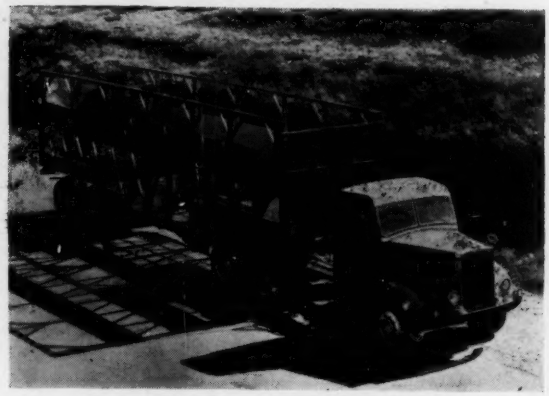
Cane Transport in Natal. Leyland Motors Ltd., Leyland, Lancs.

The illustration shows one of four cane transporters supplied to Sir J. L. Hulett & Sons Ltd. for use at Delville Estates Ltd. in Zululand. Well over 40 ft long and 8 ft 2½ in wide, they are 5–axled



articulated vehicles consisting of diesel-engined Leyland "Super Hippo" six-wheeled tractors each coupled to a 36 ft long Hilo semi-trailer. These trailers weigh only 13,800 lb and carry a payload of 20 tons of cane.

* * *

Portable Conveyors. C. H. Johnson (Machinery) Ltd., Adswood, Stockport, Cheshire.

The Johnson "Hylo-Veyor" "LA" and "MA" portable conveyors are representative of a complete range of portable conveyor-elevators. The "MA" type is a large-range discharge height type with hydraulic jacking, carrying up to 100 tons per hour on materials at 50 lb per cu ft. It is available in 30 ft. 36 ft and 42 ft lengths and may be fed either from a portable hopper or from the Johnson "Loband" loader —a short centre band conveyor fitted with a flat

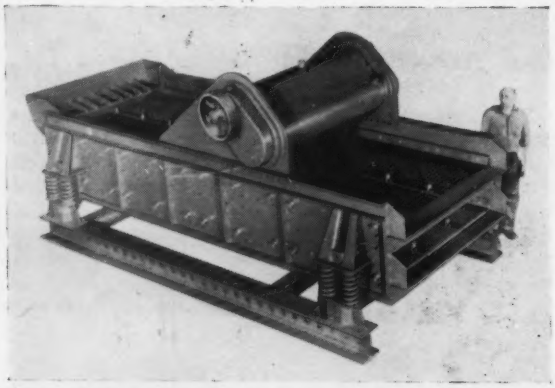
hopper to take the discharge direct from tipping and telescopic trucks. The conveyor is provided with slewing wheels to enable it to slew around the hopper.

The "LA" type are lightweight conveyors of up to 80 tons per hour capacity and available in 20 ft and 25 ft lengths, while the "Hylo-Veyor" is a heavy-weight machine of capacity up to 200 tons per hour and available in lengths of 40 ft to 62 ft with discharge heights up to 30 ft, using hydraulic jacking.

* * *

Heavy-Duty Vibrating Screen. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

The illustration shows the new heavy-duty "Straight-line" horizontal vibrating screen, CL-Model 58, which may be cable suspended or floor mounted and is actuated by unbalanced shaft vibrators. It



has been designed for quick replacement of bearings and screen decks, and is capable of taking wire cloth, perforated plates or wedge wire screens. Single or double decks are available in 15 sizes ranging from 4 × 8 ft to 6 × 16 ft.

* * *

Hesser Packaging Machinery. Fr. Hesser Maschinenfabrik A.G., Stuttgart-Bad Canstatt, Germany.

A high-speed machine, Type PU IV, equipped with 6 precision electric weighers has been supplied to an Italian sugar refinery where it is working with an output of 120 packs per minute, to be increased to 250 per minute by fitting rotary weighers. This machine takes the folded flat, previously side seam-glued carton "skillets" from a magazine, opens them, seals the bottom, fills and seals the top closure. Model PHBR III (see illustration) with a built-in printer uses single paper instead of double-bags and can be coupled to a parcelling machine to give automatic operation from reel of unprinted paper to parcels. Output depends on the size of the plant and material packed, with a maximum of 75 packs per minute. The manually operated type GGK precision weigher is suited to the very accurate weighing of granular materials such as sugar and is robust and reliable.

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PUBLICATIONS RECEIVED.

HINDLE-HAMER LEAKPROOF GATE VALVES. Joshua Hindle & Sons Ltd., Neville Street, Leeds 1, Yorkshire.

The valves described are designed to overcome the leakage which often occurs with gate valves after repeated operation. In their design they have, in addition to a precision-fit metal-to-metal contact of the wedge, a pair of P.T.F.E. seals which press against the wedge and also stainless steel locking rings and seats which are not attacked by corrosive fluids.

* * *

SMITH "BRUSCO" SUGAR MILL ROLLERS. A. & W. Smith & Co. Ltd., 21 Mincing Lane, London E.C.3.

Illustrations show casting and machining of Smith rollers as well as the finished product which is of a special mixture of hard open-grained cast iron which, while of extreme hardness combined with a coarse texture, retains a rough and exceedingly good gripping surface throughout the life of the roller. An insert gives a diagram of a roller, indicating the dimensions etc., required for replacement.

* * *

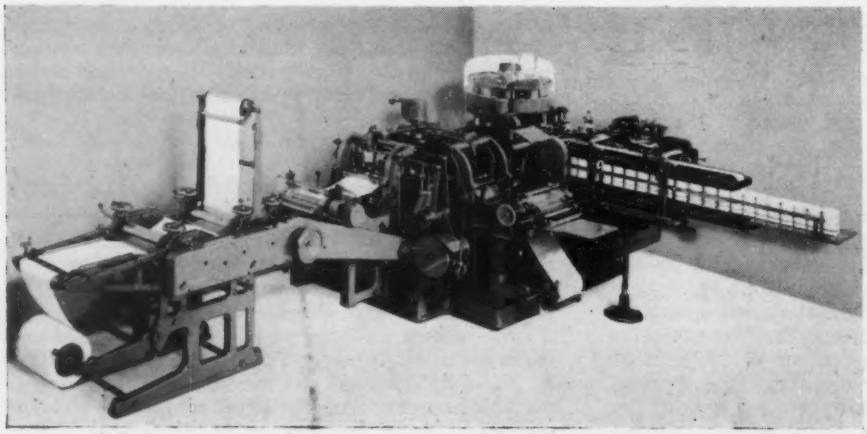
MARTIN-MARKHAM PRODUCTS. Markham Traction, Ltd., Stamford Lincs.; Martin's Cultivator Co. Ltd., Stamford Lincs.

A new folder contains leaflets describing the range of equipment made by these two associated companies, including the Markham 5-ton rubber-tyred cane carts which can be linked to form trains; Martin disc ploughs, cultivators, hoes, tool bars and harrows; and Markham fertilizer distributor, trailers, hydraulic loaders, and concrete mixer.

* * *

"ST. MARTIN'S" NYLON SIFTING CLOTH. Henry Simon Ltd., Cheadle Heath, Stockport, Cheshire.

A booklet of technical data on "St. Martin's" cloth mentions that it was introduced originally for the flour milling industry, but that it has since found application in many industries including use for separating solids from fluids. It is available in standard and heavy qualities with a wide range of meshes, and is generally supplied in 40-inch widths. Advice is given on storage, fitting and cleaning the cloth, with further details on the physical and chemical properties of the "Nylon" used.



WORLD SUGAR PRODUCTION

World production of *centrifugal* cane and beet sugar for 1957/58 is estimated at 50,070,000 short tons, raw value, a new high record crop, according to the Foreign Agricultural Service of the U.S. Dept. of Agriculture. This compares with 45,743,000 tons for the 1956/57 crop, an increase of 4,327,000 tons, or approximately 9·5%.

World production of *non-centrifugal* sugar is estimated at 8,197,000 tons as against 8,347,000 tons produced in 1956/57, a decrease of 150,000 tons, equivalent to 1·8%.

The estimates for the 1957/58 crop by continents, together with comparisons for previous years, according to the Foreign Agricultural Service of the U.S. Dept. of Agriculture, as as follows:—

Continent	Crop Years 1954-55	1955-56	1956-57	1957-58*
	(In thousands of short tons, raw value)			
CENTRIFUGAL SUGAR				
North America ..	13,236	12,935	14,481	14,604
Europe†	13,891	15,307	15,206	17,667
Asia	6,036	6,699	6,897	7,795
South America ..	5,002	4,899	5,230	5,728
Africa	2,246	2,457	2,428	2,656
Oceania	1,585	1,455	1,501	1,620
Total centrifugal sugar	41,996	43,752	45,743	50,070
NON-CENTRIFUGAL SUGAR‡				
North America ..	274	261	271	293
Asia	6,381	6,268	7,049	6,867
South America ..	1,045	1,033	1,027	1,037
Total non-centrifugal	7,700	7,562	8,347	8,197
GRAND TOTAL ..	49,696	51,314	54,090	58,267

"Non-Centrifugal" includes sugars known as piloncillo, panela, papelon, chancaca, rapadura, jaggery, gur, moscovado, panocha, etc.

* Estimated.

† Including Russia.

‡ As made, not converted to raw value.

New **Israel Refinery.**[1]—A new refinery is to be established at Kiryat Gat having an initial output of some 13,000 tons of refined sugar from 100,000 tons of beet per annum. It is expected that this stage will be reached in about 18 months. Later the plant will be expanded so that some 160,000 tons of beet can be processed, giving a refined sugar outturn in the region of 21,000 tons. Two plants, at Afuleh and Ramat Gan, are already in operation and produce 15/17,000 tons of refined sugar per year, against the domestic consumption of about 60,000 tons.

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Indian Export Quota.[2]—The Indian Government has released 50,000 tons of sugar for export during the current season ending October 31st. An official Press note announcing this also said that the Indian Sugar Mills Association, Calcutta, was being appointed as the export agency for the purpose. All sugar factories in the country were to deliver their export quotas to the Association. They would be paid for the quantity delivered at a uniform rate based on the net prices realised by the Association from the sale of the sugar. The official release said that production during the year would be 1,975,000 tons and that there would be a substantial carry-over at the end of the season. If, nevertheless, there was any undue rise in prices, the Government would not hesitate to take measures to bring down prices to a reasonable level, the note concluded.

BREVITIES

Mexican Mill Expansion.[3]—A credit of $3 million to finance the export of U.S. machinery and equipment to a Mexican sugar mill has been announced by the Export-Import Bank of Washington. The mill, Ingenio "El Potrero" S.A., of Veracruz, is undertaking an expansion programme which will cost more than $6 million. When this is completed, annual production of refined sugar will have increased from 55,000 to 90,000 tons.

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Record Year for Dominican Republic Refinery.—The Rio Haina refinery, which has the largest milling capacity in the world, according to the Dominican Sugar Council, processed a record tonnage of sugar in its 1957/58 season just ended. In seven months, a total of 1,553,126 tons of sugar cane has been ground at the refinery, producing 144,970 tons of sugar and 9,240,662 gallons of molasses. This compares with the 1956/57 sugar season figures of 120,630 tons of sugar and 7,529,507 gallons of molasses.

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Turkey Sugar Production, 1957.[4]—A total of 15 sugar factories in Turkey produced 320,950 metric tons of white sugar from 2,197,680 tons of beet in 1957, compared with 276,557 tons of sugar from 1,791,192 tons of beet in 1956, according to statistics issued in Ankara. Two new factories in Ankara and Adana are expected to increase total sugar output by some 60,000 tons. Turkish sugar exports in 1957 exceeded 27,000 tons, compared with 7000 tons in 1956. The bulk of the exports was shipped to Western Asia at prices averaging $109 per ton. Observers in Ankara claim that at the official exchange rate this would mean that the export price ranged from 25 to 30 piastres per kilo, while production costs are 110 piastres and the domestic retail price 300 piastres.

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The Japanese Beet Sugar Industry.[5]—There are at present four beet sugar factories in operation in Hokkaido of which 3 belong to Nihon Tensai and one to the Shibaura Seito Kaisha Ltd. The result of this year's campaign is estimated at 85,000 tons of sugar. The Hokkaido Farmers' Association is at present constructing another sugar factory which is to open some time in the autumn. Two more factories, one of which is being built by Nihon Tensai and the other by the Taito company are to start production in 1959. It appears that other companies, too, would like to join the beet sugar industry but it is doubtful whether they will be supported by the Government. An area of 57,000 hectares with 9 or 10 factories having a capacity of 1200 tons each is considered the maximum. In 1957, 23,534 hectares were planted and this year's area is reported to be slightly more than 30,000 hectares.

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Effects of the Hawaiian Sugar Strike.[6]—The "Review of Business and Economic Conditions" prepared monthly by the Bank of Hawaii has listed the following points in connexion with future Hawaiian sugar production: (1) Many areas planted prior to the strike that would normally be harvested next year are so seriously damaged that they must be replanted; (2) Practically all fields (particularly of young cane) have suffered setbacks and will not yield as much sugar as they would have under normal conditions; (3) For over four months no new cane fields have been planted; hence future harvesting schedules are disrupted—a factor which will show up to late 1959 and early 1960 rather than this year; and (4) Weeds, rats, insects and plant diseases have been out of control—hence time will be required to eradicate them. A production estimate by the H.S.P.A.[7] of 820,000 short tons, however, may well mean that Hawaii will be able to ship and deliver her present U.S. quota of 750,000 tons.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1958, (361), 117.
[2] *Public Ledger*, 5th July, 1958.
[3] *Willett & Gray*, 1958, **82**, 191.
[4] *Public Ledger*, 31st May, 1958.
[5] *Zeitsch. Zuckerind.*, 1958, **83**, 251.
[6] F. O. LICHT, *International Sugar Report*, 1958, **90**, (6), 8.
[7] C. Czarnikow Ltd., *Sugar Review*, 1958, (362), 120.

BREVITIES

New Indonesian Factory.[1]—Construction of the sugar mill at Padokan in the district of Jogjakarta on Java, the contract for which was concluded with Eastern Germany in 1955, should now have reached completion as the season was due to start on 1st June. The mill will have a processing capacity of 2000 tons of cane per day over a 100-day season and will employ about 1000 workers.

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Fives-Lille and Cail Combine.—It was recently announced that the Cie. de Fives Lille and the Société Francaise de Constructions Mécaniques (Anciens Etablissements Cail) had merged with the formation of a new Company, Société Fives Lille–Cail. The office of the new Company is at 7 Rue Montalivet, Paris (8e), France.

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Peruvian Bagasse Wallboard Plans.[2]—Plans are under way for a wallboard factory in Northern Peru that will use bagasse. The process to be adopted is new and gives as a first product a thick material resembling cardboard, which can be used as an acoustic board. Further processing produces a material with all the qualities of hardwood; it can be sawn, planed and nailed. The plant is not expected to be in operation for two years but, in the interval, wallboard will be imported from an associate organization in Cuba as soon as production begins there.

Stock Exchange Quotations

London Stocks (*at 18th July* 1958)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	10/10½
Antigua Sugar Factory (£1)	20/9
Booker Bros. (10s)	19/–
British Sugar Corp. (Ltd. (£1)	16/6
Caroni Ord. (2s)	4/7½
Caroni 6% Cum. Pref. (£1)	17/3
Distillers Co. Ltd. (6s. 8d units)	23/10½
Gledhow Chaka's Kraal (£1)	55/–
Hulett & Sons (£1)	66/6
Jamaica Sugar Estates Ltd. (5s units)	6/–
Leach's Argentine (10s units)	10/3
Reynolds Bros. (£1)	45/9
St. Kitts (London) Ltd. (£1)	51/3
Ste. Madeleine (Ord.) (£1)	25/6
Sena Sugar Estates (10s)	20/3
Tate & Lyle (£1)	56/1½
Tate & Lyle Investments Ltd. (5s)	11/4½
Trinidad Sugar (5s stock units)	11/6
United Molasses (10s stock units)	30/1½
West Indies Sugar Co. Ltd. (£1)	28/–

New York Stocks (*at 17th July* 1958)

	CLOSING MIDDLE $
American Crystal ($10)	35¼
Amer. Sugar Ref. Co. ($100)	29¼
Central Aguirre ($5)	19
Cuban American ($10)	24¾
Great Western Sugar	24½
South P.R. Sugar	26⅞
United Fruit Co.	47½
West Indies Sugar Corp. ($1)	59

New Bolivian Sugar Factory.[4]—A new sugar factory began working in Santa Aurelia in September last. It is the fourth in the province of Santa Cruz.

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New Sugar Factory for Honduras.[5]—A new sugar factory is to be built at Villa Nueva in the department of Cortes, with an annual capacity of about 10,000 Spanish long tons of white sugar.

* * *

New South African Sugar Factory.[6]—A new sugar factory is to be erected in Durban, at a cost of £1,750,000. The factory will have an annual capacity of 40,000 tons of sugar and it is assumed that operation will start in 1960.

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Red Rot in Hawaii.[7]—An outbreak of red rot cane disease was reported earlier[8] on Maui. The disease has spread to nine of the plantations and is present on all four islands. It has affected the local variety H 32–2915 which occupies about 40,000 acres or 18% of the Islands' total cane area.

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Cuban Bagasse Utilization.[9]—A plant for making artificial wood and hardboard from bagasse was officially opened on the 7th June at Cruces, in Las Villas. Production is planned to be 18,000,000 square feet of boards annually, with an approximate value of $4,000,000; of this some 70% will be sold in Cuba and the remainder exported.

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New Italian Sugar Factory.[10]—The Sardinian Sugar Company to which the sugar factory at Oristano belongs, intends to construct a second beet sugar factory at Decimomannu. Within its area 300 hectares will be planted to sugar beet and sugar production of the two factories will cover the total sugar requirements of the island which is estimated at 15,000 tons per annum.

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Larger Israeli Beet Crop.[11]—Following a 70% expansion in the area under sugar beet this year—from 3350 acres in 1957 to 5750 acres in 1958—Israel will be able to meet over a third of her sugar requirements from local production this season. The total yield of refined sugar is estimated at 14,000 tons (from 90,000 tons of beets), while consumption now runs at a rate of 50,000 tons annually. The sugar content of the beets averaged 16–17% this season.

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Bagasse Paper Research in Hawaii.—The Crown Zellerbach Corporation of San Francisco and the Hawaiian Sugar Planters' Association will launch an expanded research and testing programme this autumn to determine the commercial feasibility of utilizing bagasse as a raw material for paper manufacturing in the Hawaiian Islands. The project will include specialized pulping and refining equipment to prepare the bagasse; a large-scale de-pithing pilot plant on Oahu; and tests at Hilo and Waipahu on outdoor storage of bagasse under dry and wet weather conditions. Hawaii produces about 1 million tons of bagasse annually of which about 5% is used to make wall board, the rest being burnt as fuel.

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[1] *Zeitsch. Zuckerind.*, 1958, **83**, 198.
[2] C. Czarnikow Ltd., *Sugar Review*, 1958, (355), 93.
[3] *Foreign Trade*, 1958, 109, (11), 23.
[4] F. O. Licht, *International Sugar Report*, 1958, **90**, (6) 9.
[5] F. O. Licht, *International Sugar Report*, 1958, **90**, (6), 9–10.
[6] F. O. Licht, *International Sugar Report*, 1958, **90**, (6), 11.
[7] *Sugar y Azúcar*, 1958, **53**, (7), 28.
[8] *I.S.J.*, 1958, **60**, 183.
[9] *Havana Post*, 8th June, 1958.
[10] *Zeitsch. Zuckerind.*, 1958, **83**, 292; F. O. Licht, *International Sugar Report*, 1958, **90**, (Supp. 13), 4.
[11] *Public Ledger*, 31st May, 1958.